W. G. FARLOW.

U. S. DEPARTMENT OF AGRICULTURE.

SECTION OF VEGETABLE PATHOLOGY.

QUARTERLY BULLETIN. Vol. 5.

THE

JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

B. T. GALLOWAY,

CHIEF OF THE SECTION.

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INTRODUCTORY.

As has already been announced, the JOURNAL OF MYCOLOGY will henceforth be published by the Section of Vegetable Pathology, and will be issued quarterly instead of monthly.

The publishing of this journal is something of a departure from the work ordinarily done by this Section, and has been undertaken for somewhat different purposes.

The growth of the study of Mycology during the past twenty years has been phenomenal, and as it forms the very foundation for that more practical study, the proper means of combating the parasites which are causing such serious losses to cultivated plants, it seems highly proper that the Department at Washington should furnish all the stimulus possible for the prosecution of the study.

The law establishing experiment stations makes special mention of the study of plant diseases. In some stations work in this direction has already been started, and more will probably be undertaken in the near future. The literature on this subject is scattered through many journals and papers in half a dozen languages. It is not, therefore, easily accessible or procurable by the stations, and is altogether out of the reach of many private workers in this field. These and other reasons have made it seem desirable to bring together in some regular publication the latest and best knowledge of mycological experts, together with some account of the most important literature.

From what has been said it is apparent that the aim of this publication will be to reach and assist the workers in this difficult field rather than to prepare matter more directly for the general reader. The latter is already provided for by the issue of bulletins and in various other ways, both by this Department and by the stations themselves.

PERONOSPOREÆ AND RAIN-FALL.

By Byron D. Halsted.

The chief point in this paper is to contrast the prevalence of the *Peronosporeæ* during the past year with the quite general absence of them the two previous years. It will be necessary to state the leading difference in the rain-fall of the last two years, and as this is the only apparent element of variation, except in so far as this modifies other meteorological conditions, it is only natural to attribute the variations in amount of mildew largely to the difference in the rain-fall.

The year 1887 was an exceedingly dry one and the last growing season has been not far from the average one in moisture. In 1887, according to the weather record kept at the college (Ames, Iowa) and kindly furnished me by Professor Osborn, the showers in time and amount were as follows:

	Inches.		Inches.
Mar. 5	.10	July 17	.02
Mar. 27	.56	July 18	.30
Apr. 23	1.26	July 19	1.45
Apr. 26	.02	July 22	.13
May 14	.16	July 30	.41
May 22	.08	Aug. 5	.23
May 29	.15	Aug. 9	.11
June 6	.02	Aug. 10	.08
June 11	.20	Aug. 18	.09
June 12	.43	Aug. 20	.40
June 13	1.16	Aug. 21	.08
June 20	.23	Aug. 26	.10
July 13	.45	Aug. 30	.08
July 16	.02		

By month this gives for—

	Inches.		Inches.
March	.66	June	2.04
April	1.28	July	2.78
May	1.39	August	1.17

This is an average of only 1.39 inches per month and a total of 8.32 for that half of the year when rain is most essential for the existence and growth of vegetation. This prolonged drought was made more intense by the preceding dry year. It was in fact the second of two comparatively rainless seasons. September opened with refreshing showers, and by the close of the month the rain-fall amounted to nearly 10 inches (9.77).

For six months in 1888 the rainy days were as given below:

	Inches.		Inches.
Apr. 26–29	1.22	July 4–5	1.86
May 3-4	1.51	July 16	1.73
May 7–9	1.47	July, scattering (3)	.58
May 27–28	1.11	Aug. 5–6	.37
May, scattering (3)	.46	Aug. 10	.65
June 1	.38	Aug. 14-15	1.38
June 12	.17	Aug. 28	.14
June 20–21	1.19	Sept., scattering (4)	.16
June 27	.66		

By month this gives for—

	Inch.		Inch.
April	1.22	August	2.54
May	4.55	September	.16
June	2.40		
July	4.17	Total	15.04

It will be noticed that while in 1887 there were only three rains of over an inch in the growing season, during the past year the record shows seven. The most marked difference was in May, when 4.55 inches of 1888 stands in contrast with 1.39 inches of 1887. It should be kept in mind that May is the time when rains, if not in excess, do the greatest amount of good, as vegetation then is in a condition to profit most from showers. The amount in June remains about the same, but that for July and August is nearly double. The species of *Peronosporeæ* are taken up one by one, as this seems the best method of exhibiting the contrasts.

PHYTOPHTHORA INFESTANS, DBY. Three years ago, after an average season, there was much complaint of the rot in all parts of Iowa, and housed tubers contained the parasite in abundance. The potato crop for 1888 was very heavy, and no rot has been seen by or reported to me. The two very dry years, viz, 1886 and 1887, doubtless have greatly reduced the number and vitality of the rot spores, and done more than an average season to rapidly develop the rot.

PERONOSPORA VITICOLA, DBY. None of this mildew of the grape was found last year, although the search for it was frequently made, and in places where two years before the wild canes of *Vitis riparia*, were dwarfed and covered with a thick white felt down to the earth's surface. No signs of the mildew could be found in the large college vineyard, where many sorts of cultivated grapes and a few scattered vines of native wild species are grown. The vines were in every way healthy, and flourished when all vegetation about them was suffering with drought and heat. This season the cultivated vines suffered severely from the mildew, and nearly every leaf was more or less affected and the crop much injured.

PERONOSPORA HALSTEDII, FARLOW, is the most wide-spread species in Iowa. Its hosts are numerous, the leading ones of which are several species of *Helianthus*, *Silphium*, *Eupatorium*, *Bidens*, and a long list of other genera all of the order *Compositæ*. In 1886 this mildew was moderately common, but last year it was found only upon those composites which were in wet places. It was rare upon *Helianthus;* not found at all upon *Ambrosia artemisiæfolia*, *Solidago Canadensis*, or *Eupatorium* and *Silphium* species. In short, the genus *Bidens* was the only one which could furnish any considerable supply of specimens. *B. frondosa*, *B. chrysanthemoides*, and *B. connata*, var. *comosa*, all were infested, but these hosts grew in beds of streams where plenty of moisture reached the rank succulent plants. This year there has been a fair quantity of the *Compositæ* mildew upon the high-ground plants, especially about the middle of June, which may be accounted for by the May rains.

Peronospora obducens, Schrœt, upon *Impatiens fulva*, has not been met with during the last three years. It is not a common species in the most favorable season.

Peronospora geranii, Pk., was not found last year upon the common host *Geranium maculatum*, but in May was collected by A. S. Hitchcock upon *Geranium Carolinianum*, at Iowa City. During June of 1888 the mildew was very abundant upon *G. maculatum;* in fact, more so than any other species at that time.

In May last a *Peronospora* was found upon the common water leaf (*Hydrophyllum Virginicum*). I am not aware that Dr. Farlow, to whom specimens were sent, has determined the species. It was growing over the same areas, and closely associated with the Spotted Cranesbill affected with *P. geranii.* It is very interesting to note that the same species was first discovered by Mr. Holway about a fortnight earlier, at Decorah, Iowa, and also found by Mr. Hitchcock, of Iowa City, at almost the same time as at Ames.

Peronospora pygmæa, Unger, on *Anemone* sp., was not observed last year, but in 1888 it flourished in late May and early June.

Peronospora gangliformis, DBy., occasionally appeared upon the lower leaves of *Mulgedium leucophæum*, in 1887. The other hosts prefer dry ground, and in their dwarfed condition were not infested. During the year just closed it could be said to be common upon *Prenanthus* and *Lactuca* hosts.

Peronospora parasitica, Tul., is one of the most common species upon various cruciferous hosts. In ordinary seasons *Lepidium Virginicum*, is badly infested, having its branches strangely distorted. Last year the pepper-grass was quite free from the parasite, if we except the seedlings, which were attacked for a few weeks in spring. The *Peronospora* was most abundant upon *Nasturtium palustre.* In June the lower leaves of the host, lying close to the moist ground of borders of streams, were quite generally affected. A little later, when the drought had progressed, it was not abundant. In some specimens the conidiophores were not more than one-fourth the normal size. Early in 1888 the mildew was abundant upon the pepper-grass, and continued so until July.

Peronospora potentillæ, DBy., was common on *Potentilla Norvegica*, early in 1887, when the host was growing on the borders of low wet places. It disappeared as the dry weather of late spring arrived. Last season it did not appear in abundance until July, when whole large plants were found attacked.

Peronospora Arthuri, Farlow, was not common three years ago, but during 1886–'87 it was found only on a few plants growing along the shady bank of a stream. It has not been common the last season and is peculiar in only attacking here and there a whole plant.

Peronospora effusa, Rabh., is a common species upon *Chenopodium album*, but was far less abundant than usual during the two dry seasons.

Peronospora polygoni, Thüm., is rare on *Polygonum dumetorum.* Mr. Hitchcock found the mildew upon *P. aviculare*, at Iowa City in May of 1887, but it was not at all common. It was abundant upon *P. convolvulus* in July of the last season.

Peronospora alta, Fckl., has been almost entirely absent from *Plantago major*, for the last three years. In 1885 it was one of the easiest of the Peronosporas to obtain in quantity.

Peronospora trifoliorum, DBy., has heretofore been one of our most common species upon *Astragalus Canadensis*, and especially on *Vicia Americana*. Upon the latter two years ago it was so abundant as to almost destroy the host in whole patches. It was found in 1887 only after diligent search in the moistest places where the vetch will grow. It again appeared in 1888 but in milder form than before the dry years.

Peronospora euphorbiæ, Fckl., is a species which quickly disappears in times of drought. It is not uncommon on *Euphorbia maculata*, in a wet season, but rare indeed in 1887. The usual amount was met with in 1888 noticeably dwarfing the small leaves of the host.

Peronospora leptosperma, DBy., was common in 1885 on both *Artemisia biennis* and *A. Ludoviciana*. During 1887 it was met with in only a few places on *A. biennis*, growing in moist spots near excavations along a railroad track. Last season found it abundant again.

Peronospora sordida, Berk., is a good illustration of the influence of moisture upon the development of *Peronosporeæ*. The host *Scrophularia nodosa* is a common plant on the banks of streams, especially where the surface is without sod. In 1887 the mildew was abundant in only one place—a bend of a stream where the host grew close to the water and could obtain moisture freely. It was not at all uncommon during the last growing season.

Peronospora lophanthi, Farlow, on *Lophanthus scrophulariæfolius*, is a rare species in Iowa and was met with only in 1887.

Peronospora graminicola, Schrœt., which was abundant in 1886 upon *Setaria viridis*, transforming the inflorescence of the grass into strange shapes, was far less common during 1887. Last autumn it infested the foxtail quite generally and appeared to some extent upon the Hungarian grass. This new parasite may do much mischief in the future.

Peronospora calotheca, DBy., is not rare upon species of *Galium*. In October, 1887, seedling plants, which had come up in a rich mold since the September rains, were badly infested. This is a good illustration of fresh, growing tissue being favorable for the development of *Peronosporeæ*.

The genus *Cystopus* has four species common to Iowa.

Cystopus candidus, Lév., like *Peronospora parasitica*, is confined to the *Cruciferæ*, and also like it lives over the winter within the tissue of the seedling plants. There was an abundance of the *Cystopus* on Shep-

herd's-purse seedlings in the spring of 1887, and it produced a large crop of spores which did not spread the trouble rapidly to other plants as in an ordinary season. In June there was very little of the mildew and only a few spots could be seen on the seedlings in the autumn. Only a small amount of the fungus was found the next spring. The mildew was fairly abundant upon the common pepper grass (*Lepidium Virginicum*), but soon disappeared. Three years ago in a moist season the blossoms, flower stalks, and seed vessels of the garden radish were generally attacked and often distorted beyond recognition. Very late in October, 1887, the mildew was found prevalent upon seedling plants of *Sisymbrium officinale*, which had developed after the September rains in a shady place. Last year there was very little of the mildew upon the Shepherd's-purse. The two dry years had done much toward eradicating it along with the host.

CYSTOPUS CUBICUS, LÉV., is the least common species of the genus, and for the last three years has been found upon *Ambrosia artemisiæfolia, C.*, only at rare intervals.

CYSTOPUS BLITI, LÉV., occurs upon an increasing list of hosts. *Amarantus blitoides*, was badly infested in all three seasons, and as this species flourishes in dry places, upon paths, and roadways it at first seems an exception to the rule. However, this Amaranth is thick-leaved and succulent, and like the purslane is full of moisture, even though the surroundings are arid. It was a fact of observation that the greatest development of the mildew was upon plants which were most favored with moisture and shade.

CYSTOPUS PORTULACÆ, LÉV., is the last species of the list and one of no little interest in the present connection. It seems to have been more abundant during the two dry seasons than before or since. The host is a juicy plant and the appearance of greater thrift on the part of the parasite may be due to the fact that it was more than usually destructive, the purslane not being able to withstand its attacks. Therefore a patch of the host while showing more of destructive effects of the mildew might in fact have less of the parasite. It is impossible to say there was more or less of the mildew the last year than the season preceding. These observed facts seem to show that with the *Peronosporeæ* there is no doubt that the species are best suited to a moist season. The members of the genus *Peronospora* have in no instance been so abundant during the two dry years as before or since the drought. In general the mildews were found in early spring in 1887, after this, through the long dry summer, in limited quantities, upon plants growing in moist places along streams and edges of pools. In 1888 the greatest abundance was in June after the May rains.

The genus *Cystopus* seems less influenced by drought, but as a rule the infected specimens were those best situated for obtaining moisture. In all cases where *Peronosporeæ* flourished in drought, they were upon succulent hosts, and even with these there was probably less growth of

parasite but a greater manifestation of disease due to lack of vitality in the hosts. These instances, therefore, form no exception to the general rule, that dry weather is not advantageous for the development of the *Peronosporeæ.*

In preparing this paper the writer has drawn freely upon his article "Downy Mildews in a dry Season" in Ames' (Iowa) College Bulletin, 1888, which gives an account for the years 1886 and 1887, and in some instances the form of statement therein used is here reproduced.

AN INTERESTING UROMYCES.

By Byron D. Halsted.*

The following description is of a *Uromyces* collected the past autumn, which has the habit of infesting the perigynia of a sedge, causing them to assume a quite unnatural dark color before their time of maturing.

Uromyces perigynius, Halsted. Sori one-half to 2^{mm} in diameter, forming dark-brown, nearly globular patches upon the outside and between the veins of the perigynia, not infrequently upon both surfaces of the younger leaves, where the patches are often three times as long as broad. Teleutospores somewhat variable, 4–6 by 8–10μ, with a prominent brown free end ranging from acute to wedge shaped. Contents usually granular and often with a large oil globule. Pedicel two to three times the length of the spore, slender and hyaline.

On *Carex intumescens*, near Ames, Iowa, September, 1888. D. G. Fairchild.

The other known species of *Uromyces* upon *Carex* is *U. Caricis* of Peck (Mycotheca Universalis No. 746), which is very different in habit and characteristics of the spore. It is reported only upon *Carex stricta* and not upon the perigynia. In making the comparison it was interesting to observe that with *U. Caricis, Pk.*, there were ocasional double spores among those of normal form. Sometimes a half dozen adjoining spores in a partially crushed sorus would be of the puccinia type. Those who are subscribers to Ellis and Everhart's N. A. F. may expect the *Uromyces* above described in the next issue.

NEW SPECIES OF KANSAS FUNGI.

Rev. Myc. XI. 63

By W. A. Kellerman and W. T. Swingle.

Tilletia buchloëana *n. s.* In the much enlarged and mostly globular ovaries of *Buchloë dactyloides*, abnormally borne on the male plants; often all or nearly all the staminate spikelets produce the ovaries, all of which are infested. Spores dirty brown in mass, as seen

* Rutgers College, New Brunswick, N. J.

singly dusky or brownish fuscous, never very dark, perfectly spherical or very slightly oval, regular in size, $16\frac{1}{2}$–21μ diam., but mostly 18–20μ (exclusive of hyaline envelope). The outer wall of the spores is marked with scattering, regular spines or faint reticulations (formed by coalescence of the spines?) $\frac{1}{2}$–$1\frac{1}{2}\mu$ high, but completely enveloped by the outer hyaline layer, which is $1\frac{1}{2}$–4μ thick. The outer wall is about $1\frac{1}{2}$–2μ thick, and is the darkest colored part of the spore; immediately within this is a thinner, clear, lighter colored wall $\frac{3}{4}$–1μ thick; following this is a layer of variable thickness, usually finely but sometimes coarsely granular. In the center of the spore is a very light homogeneous usually spherical body 7–10μ, mostly $7\frac{1}{2}$–9μ in diameter.

On male plants of *Buchloë dactyloides*, western and southwestern Kansas (Trego County, 1886, and Ford County, June, 1888).

In some cases, especially in young spores, the hyaline layer is seen to be made of two distinct layers, the inner extending from the wall to the tips of the spines and being slightly darker than the outer layer. The immature spores when placed in water become very much swollen and are almost colorless, except the collapsed central body. Mixed with the spores were seen in many cases a hyaline, branched, septate mycelium, 3–$4\frac{1}{2}\mu$ diam., but whether connected with the spores or not can not be said. Attempts to induce germination of the spores failed.

The infected plants are easily detected by their apparently denser and darker inflorescence, but the monstrosity consists solely in the production of ovaries in the male plants. These are in every case filled with the mass of spores and are very much enlarged pushing the glumes wide apart. In size the smutted ovaries are 1.3–1.8 by 0.6–1.3^{mm}. The few female plants collected in the same localities were free from the fungus. Figs. 1–11.

USTILAGO ANDROPOGONIS, *n. s.** In the ovaries of *Andropogon provincialis* and *A. Hallii*, not only the sessile flowers (which are perfect), but also the pedicelled ones, which are normally staminate, often produce the cylindrical elongated infested ovaries; spores in mass intensely black, as seen singly dark brown or black, subglobose or slightly oval, sometimes oblong elliptical or ovate, slightly angular. Wall thick ($\frac{3}{4}$–2μ, mostly $1\frac{1}{2}\mu$) very finely and closely echinulate. Contents coarsely and evenly granular or sometimes homogeneous, 12–19μ by $9\frac{1}{2}$–16μ, mostly $13\frac{1}{2}$–$15\frac{1}{2}\mu$ by 11–14μ.

* Since sending the description of this species to the printer we have received Ellis & Everhart's North American Fungi Cent. XXIII. No. 2265 *Sorosporium Ellisii*, var. *occidentalis*, on *Andropogon furcatus*, Bismarck, Dak., August, 1884, A. B. Seymour, is the same as *Ustilago andropogonis*, Kell. & Sw. The Dakota specimens were examined by us as were the youngest Kansas specimens (collected June 26, 1888) but in none could the spore masses characterizing *Sorosporium* be seen. Besides, the spores are larger and different in color, shape, thickness, and character of wall, number and size of spores, etc., from *Sorosporium Ellisii*. The species as far as can be determined without a knowledge of the germination of the spores certainly seems to be a good *Ustilago*. No. 2265, *b*. N. A. F. on *Andropogon Virginicus*, Newfield, N. J., is apparently different from the above and a true *Sorosporium*.

The spores found on *Andropogon provincialis* are somewhat narrower and longer than on *A. Hallii*, and more often oval than subglobose. They were also more variable in size and shape. On *A. provincialis* the spores were 12–19 by $9\frac{1}{2}$–$13\frac{1}{2}\mu$, mostly 13–16 by 10–$13\frac{1}{2}\mu$, while on *A. Hallii* they were 13–$18\frac{1}{2}$ by 11–16μ, mostly $13\frac{1}{2}$–15 by 13–14μ. Attempts to induce germination failed.

Southwestern Kansas, June, 1888. On *Andropogon Hallii*, Seward County, June 26, and on *A. provincialis*, Harper County, July 14, 1888. The affected ovaries on *A. provincialis* are 2.5–7 by 1.2–8^{mm}, and those *A. Hallii*, 6–8 by 1.4–8^{mm}.

This species is clearly distinct from *Ustilago Ischaemi* Fckl., and *U. cylindrica*, Pk. both in size of spores and in being confined to the ovaries. Figs. 12–26.

USTILAGO BOUTELOUÆ *n. s.* In the enlarged ovaries of *Bouteloua oligostachya;* spores in mass, brownish; when seen singly, dark brown or sometimes light brown, oval, subglobose, or elliptical, regular or sometimes slightly angular; wall thin (about $\frac{1}{2}\mu$) irregularly, rather sparingly, tuberculate–echinulate (spines short, $1\frac{1}{2}$–3μ apart); contents homogeneous or often containing a single large granule, 8–12 by 6–10μ, mostly $8\frac{1}{2}$–10 by 8–$9\frac{1}{2}\mu$. Germination in water by means of a septate promycelial tube bearing one or two elongate cylindrical sporidia just below the septa at the end. Promycelial tube simple or rarely branched, hyaline, 2–4 septate, 25–50μ by 2–4μ. Sporidia cylindrical, ends subacute, hyaline, 9–13μ by 2–$2\frac{1}{2}\mu$.

Mixed with the spores in some cases were seen hyaline bodies of varying sizes composed of cells somewhat smaller than the spores, arranged in a sublinear manner. The spores germinated readily in water at a temperature of 37° C. and the promycelial tubes often separate readily from the spores when they have attained their growth. The sporidia were observed budding in a few cases.

On *Bouteloua oligostachya*, Manhattan, Kans., autumn and winter, 1888. In many cases the affected plants could be detected at a glance, as the spikelets were retained long after they had fallen from the healthy plants. The smutted ovaries are 1.5 – 4.6 by 0.8 – 1.7^{mm}.

The grasses attacked by the three preceding species of fungi are important for the West. They furnish a very large part of the pasturage, and even a considerable portion of the hay crop. The smuts, preventing the formation of seed, will therefore, when abundant, likely do damage of much consequence.

ÆCIDIUM DALEÆ *n. s.* Spots none; æcidia on the leaflets or rarely on the petioles, mostly hypophyllous but often also sparingly epiphyllous, numerous, crowded, occupying from a third to the whole of the leaflet, which becomes yellowish in color as far as attacked. Peridia white (or pinkish?), usually slender ($\frac{1}{5}$–$\frac{1}{3}^{mm}$ diameter), of moderate length ($\frac{1}{6}$–$\frac{1}{3}^{mm}$), cylindrical or very often constricted above, open from the first, never hemispherical; margin crenate, subentire, or crumb-

ling or lacerated into many short erect or slightly reflexed segments. Peridial cells, below small and polygonal, above very large and having a flattened conical portion projecting outward and upward from the inner side, sometimes containing a few yellow granules, 18–42 by 15–36μ, wall 2–5μ thick, conspicuously tuberculate, the warts forming short lines or clusters on the surface. Spores yellow or at length pallid, subglobose or oval, regular or slightly angular, 23–32 by 18–25μ, mostly 24–28 by 21–24μ, wall 2–4μ thick, marked with both very fine warts and short, very blunt, round tubercules 1–2μ in diameter, which are wanting on the two attached surfaces but extend around the spore in a band, becoming closely crowded midway between the attached surfaces. Spermogonia amphigenous, scattered, immersed, globose or flask shaped, about 100μ in diameter, scarcely visible except in section.

On *Dalea laxiflora*. Rockport, Rooks County, Kans., June 12, 1888, E. Bartholomew, No. 228.

This is a peculiar and well-marked species. The upper peridial cells on the inner surface overlap somewhat like the scales of a fish, but also project outward. They are also remarkable for their great size. When the æcidia occur on the petioles they cause an enlargement, but on the leaflets scarcely any thickening can be observed. Mr. Bartholomew remarks that the species is " very abundant, making many of the host plants entirely abortive."

A STUDY OF THE ABNORMAL STRUCTURES INDUCED BY USTILAGO ZEÆ MAYS.[1]

(Plates II, III, IV, V, VI, VII.)

By Etta L. Knowles.

The fungus known as *Ustilago Zeæ Mays* is found on Indian corn everywhere. It appears in stem, leaf, grain, and in both staminate and pistilate flowers, producing an abnormal growth of tissue sometimes as large as a man's fist, whitish at first but black when the spores ripen, which is about the time of the ripening of the corn.

In order to understand the changes which are produced by the fungus, a careful study was at first made of the normal structures. Alcoholic material gathered July 19, 1887, was used for this purpose and also for the study of the abnormal structures. Schulze's solution was used for staining the sections and glycerine for mounting them. The drawings were all made with a camera and are on the same scale.

Upon examining the stem it was found to consist of an epidermal system and scattered fibro-vascular bundles, of a somewhat oval form in cross section, between which were the rather large cells of the ground

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[1] This work was carried on under the direction of Prof. V. M. Spalding, in the botanical laboratory of the University of Michigan, 1888.

tissue. The latter were hexagonal in cross, and rectangular in longitudinal section, Figs. 1 and 2. Their walls are rather thick and contain numerous thin places which are elliptical in form and lie with their long axes perpendicular to the axis of the stem. Many of these seem to have broken through and formed openings from one cell to the next. The intercellular spaces are small. The size of these cells varies with their position, those midway between two bundles being larger than those immediately adjacent to them.

The bundles are scattered through the ground tissues at somewhat regular intervals, always with the phloëm turned toward the epidermis. Near the periphery of the stem they are packed more closely together, with very little of the ground tissue between, Fig. 3. They are of the form known as the closed collateral bundle. Within the xylem and toward the inner side of the bundle is a space, Fig. 4, *a*. Partially surrounding it is the xylem parenchyma, which is composed of small elements with thinner walls than are found in the adjacent tissue. Back of this canal and partially projecting into it is an annular vessel, *b*. At each side of the bundle is a large duct, *c*, with thick reticulated walls. Between the ducts and back of the annular vessel are thick-walled elements, the tracheides. Between the tracheides and ducts and the external part of the bundle is the phloëm *d*, consisting chiefly of sieve tubes and cambiform cells. The latter, small, thin-walled, square, or rectangular, sometimes narrow or obliquely four sided elements, are distributed among the sieve tubes, which are rather large, thin-walled, polygonal elements. Both sieve tubes and cambiform cells are filled with a granular protoplasm. The elements of the bundle sheath *e* have thick pitted walls. It is developed best at the ends, particularly at the outer end, where it may consist of several layers. At the sides it often borders directly on the ducts. In longitudinal sections, Fig. 5, all of the elements are found to have transverse septa, except those of the bundle sheath, in which they are oblique. The sieve tubes are longer than the cambiform cells, and have the characteristic callous plates. The annular vessels are seen to consist of a very thin-walled portion, which is held open by thick rings placed at nearly regular intervals, *g*. The bundles just under the epidermis are usually somewhat different from those just described in that the larger intercellular space is partially or wholly absent.

The epidermis is made up of cells, which are represented in cross section in Fig. 3, *a*, in longitudinal section in Fig. 6, *a*, and in surface view in Fig. 7, *a*. As seen in the two latter they are elongated cells with slightly sinuous outline and thick pitted walls, the outer of which is somewhat the thicker and covered with a thin cuticle. In longitudinal sections and in those which show surface views there are seen to be two kinds of cells, those already described and short cubical cells. The latter are found usually one at each end of a long cell, but sometimes there are several of them together. The sub-epidermal tissue consists of

several layers of sclerenchymatous elements, Fig. 3, *b*, which are similar in appearance to those of the bundle sheath. Numerous stomata were found, each consisting of two guard cells, Fig. 7, *b*, and a pair of accessory cells, *c*. In surface view the former are dumb-bell shaped, fitting closely together at their ends, while the latter are nearly semicircular in outline.

Sections were then taken of a diseased portion of the same stem, of which the normal structure had been studied. The abnormal growth forms a more or less elongated mass at the side of the stem. Fig. 8 is a digrammatic representation of a cross section through a diseased portion, *b;* *a* represents the stem and *c* the outgrowth from it. The part of the stem at *b* seems to be little changed in structure, but at *a* quite the reverse is seen. At the latter point the bundles especially were very much distorted, being swollen to several times their normal size through cell multiplication, and in longitudinal section those lying adjacent to *c* were seen to be sending numerous small branches into it. Getting a very early stage, Fig. 9, the first change noticed was a separation of the epidermis, together with its two or three layers of sub-epidermal tissue, *a*, from the parts lying directly underneath, by one or two layers of cells, *b*, similar to those of the ground tissue and containing starch grains. In the normal stem examined the sub-epidermal layers were so closely connected with the bundle sheath of the peripheral row of fibro-vascular bundles that no line of division could be traced separating the two. Taking sections where the distortion was in all grades of development, it was found that as the abnormal tissue developed this space increased, until, instead of one or two layers of cells, as at first, there was a mass of cells separating them, thick walled in early and thin walled in later stages. The walls of the epidermal cells also became thin. For the most part, then, the abnormal tissue appears to grow in between the epidermal system and the outer row of fibro-vascular bundles, the latter taking part to the extent of sending into it numerous branches. In order to accommodate this great increase of tissue, the epidermal cells stretch and divide and change their form from that seen in Fig. 7 to that seen in Figs. 10 to 14.

The stomata are distorted in the manner shown in Figs. 11, 12, 13, and 14. An attempt was made to trace the changes which take place in the accessory cells from the normal form seen in Fig. 7 *c*, to the distorted form represented in Fig. 14 *b*. Fig. 14 was from a section cut from a place where the spores were nearly ripe, while Figs. 11, 12, and 13 were taken from the surface of tissue which was not so well developed, and represent three forms intermediate between the normal form Fig. 7 and the distorted form Fig. 14.

The cells of the ground tissue were found to be different in form according to their position. Those in the region of active growth, that is, in the region adjacent to the normal part of the stem, Fig. 8 *d*, were seen to be of the form of those represented in Fig. 15, very thin-walled,

the long axes of the cells lying parallel to a tangent drawn to the nearest point of the original stem. Each was completely filled with material for growth. Passing farther out this form gradually changes first to that represented in Fig. 16, then to a form like those in Fig. 17, then to smaller cells again, and covering all the epidermal cells, as shown in Fig. 18. The cells described above all had thin walls, without pits or openings. In most of them the nucleii were very large and conspicuous, especially in those represented in Fig. 18. Abnormal fibro-vascular bundles ran through the tissue, and adjacent to them the cells of the ground tissue were elongated in the direction of the length of the bundle.

In Fig. 19 a bundle is represented in which the distortion has not been carried very far. It has become a little broader by cell-multiplication, and the xylem parenchyma and tracheides as well as all of the phloëm have become very thin-walled, and give the reaction for cellulose with Schultze's Solution. In the normal structure the two former were composed of liquefied elements. Large nucleii were observed in a great many of the cells of the xylem parenchyma and in one or two cases in the sieve tubes. The cells of the bundle sheath have multiplied at both ends of the bundle, and in a more distorted bundle than the one represented were seen to also have become thin-walled. In stages a little farther on, cells which looked like those of the ground tissue, and which were filled or partially so with starch, had grown in, and separated the bundle into little groups or bundles of thin-walled cells. These branches passed out into the abnormal growth, and these branched again, forming altogether a sort of tree-like organ for the support and nourishment of the delicate tissue through which it runs. Figs. 20 *a* and 21 show longitudinal sections of the bundles as they appear in this tissue. They are composed of short, narrow, thin-walled cylindrical cells, arranged end to end. Nucleii are conspicuous in most of them, and all are filled with a finely granular substance which colors yellow with Schultze's Solution. In Fig. 21 the bundle has thrown off a slender branch at *a*. The walls of these cells had no markings, and the cells themselves appeared very much like cambiform cells, except that they were shorter, and contained conspicuous nucleii. In the normal tissue nucleii were not observed in either sieve tubes or cambiform cells. In some of the bundles similar to those figured in 20 and 21 there were one or two layers of cells at each edge of the bundle which were small and thin-walled, but showed reticulated and pitted markings. In Fig. 22 a cross section of one of these bundles is represented. In them the elements are so changed that phloëm can not be distinguished from xylem, and there are no large elements. Where the large pitted ducts run into the abnormal tissue, which usually they do not, they take a course separate from the bundles and have very grotesques forms, changing direction constantly.

The observations made upon the fungus which causes these changes

agree with the descriptions which have been repeatedly given of it. It consists of a thick-walled mycelium tube, the lumen of which is not constant in diameter, but in some places widens out and in other places is almost or apparently quite closed. The thickness of the mycelium filament also varies constantly. These coarse, tough threads are found in different parts of the stem, some at the center, others nearer to the periphery, running between the cells or into them, and with their sharp end pushing directly through the thickest walls, Fig. 24.

In fruiting, the mycelium forms a great number of short slender branches. Great masses of these are found in little nests in the abnormal tissue, Fig. 20, also Fig. 8. They are more slender and delicate than the mycelium already described and are generally of quite irregular form. Fig. 23 represents a much branched mycelium filament, which appeared in a break in a section. It appeared to have pushed its way in between the cells and not to have penetrated them. The slender filaments of these masses swell up into a form like that represented in Fig. 25, except that in many cases—indeed in most cases—the filaments lose their individual form and are more or less blended in a gelatinous, shapeless mass. Rounded places with little masses of rich protoplasm, Fig. 25 *a*, indicate spores in an early stage of formation. All stages may be found in the same mass. Fig. 26 shows later stages, where the ends of the filaments appear club shaped and within are seen the almost ripe spores. The mature spore, Fig. 27, is one celled with two walls; the outer thick, brown, and covered with spines. The inner delicate and transparent.

From the comparatively small number of species in which abnormal changes under the influence of parasitic fungi have been carefully studied, it is hardly possible as yet to venture on any general or theoretical statements concerning the pathological changes induced by such parasites. It seems best therefore, in the present instance, to simply recapitulate the injuries occasioned to the host by the fungus in question, since it is only by multiplied observations of the same kind that sufficient data can be gathered for a more general conception of the relations of parasite and host.

The changes observed in the stem of *Zeæ Mays* are briefly as follows:

An extraordinary hypertrophy of the parts of the host where spore formation takes place, the irregularity of which gives rise to peculiar and conspicuous distortion.

Microscopic examination shows: (1) Great multiplication of cells near the periphery; (2) decrease in thickness of cell walls and, in case of the bundles, of the size of the elements; in many cases a decrease in the size of the cells of the ground tissue also; (3) distortion of the stomata, particularly of the accessory cells, (4) a breaking up of the bundles and a changing of their elements, so that in many cases phloëm can not be distinguished from xylem; (5) a marked increase of cell contents.

SYNOPSIS OF NORTH AMERICAN SPECIES OF NUMMULARIA AND HYPOXYLON.

By J. B. Ellis and Benj. M. Everhart.

[Continued from page 113, Vol. iv.]

Nummularia. Tul. Sel. Carp., ii, p. 42. Stroma orbicular, cup-shaped or discoid, becoming black, marginate, the margin more or less distinctly sterile. Perithecia monostichous, peripheric, immersed. Asci cylindrical, 8-spored. Sporidia uniseriate, subelliptical, continuous, dark. The genus is too closely allied to Hypoxylon, especially the discoid forms.

A.—STROMA, CUP-SHAPED OR CONCAVE.

Nummularia discreta (Schw.), Tul. Sel. Carp., ii, p. 45 *Sphæria discreta*, Schw., Syn. N. Am., 1249. On dead branches and trunks of *Pirus Malus* and *Amelanchier Canadensis*, Newfield, N. J., on the first-named host, New England (Farlow), New York (Peck). On *Gleditschia triacanthos*, Ohio (Morgan), found also (Sacc. in Syll.) on *Sorbus, Ulmus, Cercis*, and *Magnolia*. Stroma erumpent, orbicular, 2–4 ^{mm}. diameter; cup-shaped, with a thick raised margin; dirty cinerous, then black, the concave surface at first white-punctate from the minute punctiform ostiola which in the mature state are scarcely visible. The wood beneath the stroma is marked with a black circumscribing line. Perithecia monostichous, ovate-cylindrical, nearly 1^{mm}. long, rather abruptly contracted above into a short neck, their rounded bases penetrating to the bottom of the stroma. Asci cylindrical, 110–120μ by 10–12μ. with long filiform paraphyses. Sporidia subglobose, nearly hyaline at first, finally opaque, 10–12 diameter. Sec. Cooke, Grev. xii, p. 6, the specimen of *Sphæria discincola*, Schw., in the Kew Herbarium, figured by Currey in Linn. Trans. 1858, Pl. 47, fig. 105, does not differ from *S. discreta*, Schw., but the *S. discincola* Schw. in Syn. Car. No. 63, and in Fr. S. M., p. 368, appears to be different, as may be inferred from the following description taken from Fries.

S. discincola Schw., Syn. Car. No. 63. Emersed-superficial, perithecia globose, crowded, black, truncate-annulate, covered with a cinereous white furfuraceous coat. Stroma irregular, subrotund, rugose, thin, penetrating deeply into the blackened wood. Perithecia scattered, rather large, urceolate, narrowed above into a minute round mouth, which is closed by white farinaceous matter. On the cut surface of trunks of apple trees in Carolina; rare.

Nummularia repanda (Fr.), *Sphæria repanda*, Fr. S. M., ii. p. 346 *N. pezizoides*, E. & E., Bull. Torr. Bot. Club, xi, p. 74. On bark, Ottawa, Canada (Macoun.), on bark and wood, Topeka, Kans. (Cragin), and on bark of *Ulmus Americana*, Missouri (Demetrio). Found in Europe on branches and trunks of *Sorbus aucuparia*. Stroma erumpent-

superficial, orbicular, or subelliptical, $\frac{1}{2}$–1^{cm}. diam., concave, and often with a thin, erect, rather broad margin, rufo-cinereus at first, finally black; disk mammillose from the projecting ostiola. Perithecia monostichous, immersed, ovate oblong $\frac{1}{2}$–$\frac{3}{4}\mu$, long, crowded, often subangular from mutual pressure. Asci cylindrical, subsessile, 8-spored, 110–120μ by 8μ, with long filiform paraphyses. Sporidia obliquely 1 seriate, narrow ovate, obtuse, subinequilateral, dark brown, 11–14μ by 4–5μ (15–16μ by 6–7μ, Sacc. in Syll.). Distinguished from *N. discreta* by its mammillose disk and differently shaped sporidia.

NUMMULARIA EXCAVATA,* (SCHW.), Syn. N. Am. 1250. On bark of different species of *Prunus*, Bethlehem, Pa. (Schweinitz). Rather rare. Elliptic-orbicular, 1–2^{cm}. across, surrounded and margined by the raised but not radiately fissured epidermis. Disk deeply concave, black, punctulate, with many minute scattered depressions, in the bottom of which are the ostiola. The stroma is included in a peculiar black cup-shaped receptacle, which penetrates to the wood, and is filled in the lower part with a woody pseudo-stroma (altered substance of the bark), the upper part being the true stroma, in which nestle the rather large pyriform scattered perithecia, occupying the central part and attenuated above into a black shining neck. Sporidia short elliptical, dark brown, 11.5–015.3 by 009.6–001.5μ. Allied to the preceding species, but more rare.

NUMMULARIA SUBCONCAVA, (SCHW.), *l. c.* 1251. On branches of *Viburnum dentatum*, Bethlehem, Pa. (Schweinitz). Gregarious and often confluent, erumpent $\frac{1}{4}$–$\frac{3}{4}^{cm}$ across, surrounded by the ruptured epidermis, and consisting of a black crustaceous shell, inclosing the few rather large globose-depressed perithecia, connected by a very scanty stroma. Disk subconcave, subrugose, and black. Ostiola globose-papillate, elevated, few, black, sometimes confluent, connected by a very short neck with the perithecia, which have the ascigerous nucleus white. Sporidia oblong, light yellowish-brown, 15.3–019.2 by 005.76–007.6μ, some of them slightly constricted in the middle but not septate.

B.—STROMA CONVEX.†

NUMMULARIA BULLIARDI, Tul. Sel. Carp. ii, p. 43. *Hypoxylon nummularia*, Bull. Champ. tab. 468, fig. 4. *Sphæria clypeus*, Schw. Stroma at first covered by the epidermis, soon emergent, almost superficial and free, convex, orbicular or oval, rarely of irregular shape, sometimes broadly effused, black inside and outside, punctulate from the slightly

*We are indebted to our friend W. C. Stevenson, jr., who furnished the measurements of the sporidia in this and the next species, from an examination of the original specimens in the Schweinitzian Herbarium in the Academy of Natural Sciences in Philadelphia.

† Were we to rewrite this synopsis we would leave this section (B) of Nummularia in Hypoxylon, where it was formerly included, the difference being too slight to have any real generic value.

prominent ostiola, clothed at first with the rufo-ferrugineous conidial layer. Perithecia rather large, ovate, black, loosely included in closely packed cells in the stroma, something as in *Daldinia concentrica.* Asci cylindrical, briefly pedicellate, 100–115 by 10μ, with very long and stout paraphyses. Sporidia uniseriate, elliptical, hyaline at first, soon opaque, 12–15 by 7–9μ. The hymenium in this species, as in *Hypoxylon Petersii* B. & C., is at first covered by a carnose-coriaceous membrane, which soon disappears, except around the margin. Common on dead trunks and limbs of various deciduous trees around Newfield, N. J. Mostly confined to dead oak. Sec. Cooke in Grev. XII, p. 4, *Sphæria clypeus,* Schw. is different, but Schw., in his Syn. N. Am., gives *S. clypeus* as a syn. of *S. nummularia,* and there is nothing in his herbarium at Philadelphia to show that they are distinct.

Nummularia glycyrrhiza, (B. & C.), *Hypoxylon glycyrrhiza,* B. & C. Exot. Fungi Schw., p. 285. Suborbicular, margin thin, center subpulvinate, and marked with papilliform points (ostiola), which are depressed in the center. Perithecia oblong. On bark, Surinam, South America. Stroma pulvinate, 25 by 12^{mm}. Differs from *N. Bulliardi,* to which it is closely allied, in its oblong closely packed perithecia. The foregoing is the description of this species given in Sacc. Sylloge. We have seen no authentic specimen of this but one sent from Ohio (Morgan No. 284), supposed to be this, was submitted for determination to Dr. Cooke, who was inclined to regard it as this species. In the Ohio specimen the perithecia are a little over one half millimeter long and are rather narrower than those of *N. Bulliardi.* The ostiola also are rather less prominent and are mostly slightly collapsed. The spordia are oblong, pale brown, 2-nucleate, 10–11 by 4–5μ.

Nummularia obularia, (Fr.) *Hypoxylon obularium,* Fr. Nova Symb., p. 130. "Immersum, erumpens, demum late effusum, determinatum, impolitum, stromate proprio atro, peritheciis immersis oblongis, ostiolis hemispherico-prominulis umbilicatis. Ad truncos arborum mortuos in Costa Rica, Oersted." Closely allied to *N. Bulliardi,* Tul., but differs in having its stroma connate with the matrix and inseparable from it, at first subrotund, then concrescent in a continuous crust, generally elongated; and ostiola depressed. The specimens examined by Fries were old and no trace of asci or sporidia remained. Cooke in Grevillea places this species in the preceding section, but there is nothing in the description to show that the surface of the stroma is concave.

Nummularia microplaca, (B. & C.). *Diatrype microplaca,* B. & C. Journ. Linn. Soc. x, p. 386. On *Sassafras officinale.* South Carolina (Ravenel) and Ohio (Morgan 261 and Kellerman 279). On *Persea,* Darien, Ga. (Ravenel F. Am. 255), *Anthostoma microplacum* (*B. & C.*) Sacc. in Syll. Stroma much the same as in *N. hypophlæa,* orbicular $\frac{1}{2}$–1^{cm} across, or elongated 1–2 by $\frac{1}{2}$–1^{cm}, thin, crustaceo-carbonaceous, black originating beneath the epidermis but soon bare, surface even, faintly punctulate from the minute ostiola, which are not prominent but slightly

depressed, as in *Hypoxylon punctulatum*, the opening at first filled with white farinaceous matter. Perithecia ovate-globose, small (less than one-half millimeter), monostichous. Asci (p. sp.) about 25 by 3μ, or with the short base $45–50\mu$ long. Sporidia uniseriate, ends mostly slightly overlapping, sub-inequilaterally elliptical pale brown, $4\frac{1}{2}–5$ by $2–2\frac{1}{2}\mu$. Berkeley says *N. hypophlæa* has larger ostiola and narrower sporidia. This is true as to, the ostiola, but as regards the sporidia the case is exactly the opposite. The wood beneath the stroma is stained with the same olive yellow color as the next species to which this is closely allied, but differs as stated.

NUMMULARIA HYPOPHLÆA, (B. & RAV.) Grev. IV, p. 95, *ibid.* XII, p. 7. *Anthostoma hypophlæum*, Sacc. On dead trunks of *Magnolia glauca*, Newfield, N. J. (Ellis), South Carolina (Ravenel). Stroma thin, suborbicular $\frac{1}{2}–1^{cm}$ across, slate color, originating beneath the cuticle, which is soon thrown off, slightly convex, and faintly papillose from the slightly projecting ostiola. Stains the subjacent wood yellowish or yellowish olive. Perithecia in a single layer, ovate-globose, small (one-half millimeter), abruptly contracted above into a slender neck piercing the superficial carbonaceous layer of the stroma. Asci slender (100 by 4μ) with a thread-like base (p. sp. $55–60\mu$ long). Sporidia uniseriate, lying mostly end to end, narrow, elliptical, pale brown, 2 nucleate, about 7 by $2\frac{1}{2}–3\mu$.

NUMMULARIA RUMPENS, CKE. Grev. XII, p. 8. *Diatrype rumpens*, Cke. Ann. N. Y. Acad. Sci., I, p. 185. On bark, Galveston Bay, Texas (Ravenel). Orbicular or elliptical $\frac{1}{2}–1^{cm}$ in diameter or by confluence 2^{cm} or over, and then more or less irregular in shape, thin, black, surrounded by the ruptured epidermis, roughened by the slightly prominent ostiola. Perithecia monostichous, ovate, $\frac{3}{4}$ millimeter high. Asci cylindrical, 100–115 by 10μ. Sporidia uniseriate, hyaline, then opaque, elliptical, with ends sub-acute or rounded, 12–15 by $7–9\mu$. This description is drawn from the specimens in Rav. F. Am. This seems to differ from *N. Bulliardi* in its less prominent ostiola and rather more acutely pointed sporidia; nor are there in the specimens we have seen any very perceptible remains of the overlying membrane. In our collections are specimens of what appears to be the same as those in F. Am. from British Columbia and Louisiana, as well as several of the original Texas specimens from Dr. Ravenel.

NUMMULARIA EXUTANS, CKE. l. c. Broadly effused, black, sub-cuticular, soon erumpent, thin (about one-half millimeter) papillose from the slightly prominent ostiola. "Two or three inches long, with an irregular outline, thinner than *N. rumpens*." Perithecia monostichous, depressed globose, less than one-half millimeter in diameter. In our specimen of this species from Dr. Ravenel, from his Texas collection, the asci had disappeared. The free sporidia were acutely elliptical or almond-shaped, rather variable in size, 10–15 by $6–8\mu$. Cooke says "ostiola depressed." In Ravenel's specimen they were as noted above; presenting the same

appearance as those of *N. rumpens*, from which this appears to differ in its more broadly effused, thinner stroma and depressed globose perithecia.

NUMMULARIA SUBAPICULATA, E. & E. (n. s.). On bark. Topeka, Kan. Cragin 267. Subcuticular, erumpent 1–2^{cm} across, convex, 1^{mm} thick or a little more in the center, with the sterile margin thinner. Ostiola slightly papillose, prominent as in the two preceding species. Perithecia monostichous, oblong, about three-fourths millimeter high, closely packed and more or less laterally compressed. Asci cylindrical, 90–100μ (p. sp.), with a short stipitate base, and with long stout paraphyses, as in *N. Bulliardi*. Sporidia uniseriate, oblong-navicular or inequilaterally-elliptical, pale yellowish brown, 12–16 by 5–7μ, mostly with a single nucleus and a faint, bead-like apiculus at each end. This was reported to Professor Cragin as *N. Bulliardi* Tul. It differs from that species as noted.

THE GENUS SCLERODERMA IN SACCARDO'S SYLLOGE.

By J. B. ELLIS.

This genus in Vol. VII, Part I, of the Sylloge appears to be made up of heterogeneous materials, being made to include not only the species usually known as *Scleroderma*, with a thick, corky peridium, but also species with papery-membranaceous peridium, heretofore included in *Bovista* and *Mycenastrum*. Among the latter we find *Mycenastrum Oregonense*, E. & E. This species was already sufficiently unfortunate in being overburdened with names, a comparison with authentic specimens showing it to be the same as *Bovista pila* B. & C., and *B. tabacina*, Sacc. It now becomes *Scleroderma Oregonense* and *Lanopila? tabacina*! The specific name *pila* being the one first given must take precedence, and unless the genus *Bovista* is to be abandoned I see no good reason why the generic name given by B. &. C. should not also remain. The species in question is closely allied to *Bovista nigrescens*, Pers. So closely in fact that, regarding only its external characters it could not safely be separated from that species. Its internal characters, however, are slightly different.

The true *B. nigrescens* (Sec English and Italian spec.) differs in its rather larger (5μ) spores, which are also often very slightly muriculate-roughened and have a hyaline pedicel about equal in length to the diameter of the spore, while in *B. pila* the spores are generally a little paler, not distinctly pedicellate and quite smooth. In both the capillitium is about the same, forming loose balls (2^{mm} diam.) closely packed and filling the entire peridium with a firm elastic purplish-brown mass. When examined microscopically this capillitium is seen to be made up of numerous small knots or ganglia consisting of intricately entangled

masses work of coarse, purplish-brown, branching threads 12 to 15μ. thick, which send out on all sides free, sub-dichotomously branched, sub-undulate arms tapering gradually nearly to a point and more or less distinctly granular-roughened or occasionally sub-tuberculose. *Mycenastrum corium*, Desv., of which, as shown by a comparison with authentic specimens *M. spinulosum*, Pk., is a synonym, has the capillitium of the same type only spinulose. This species is really only a *Bovista* with spinulose capillitium, and if the genus *Mycenastrum* is to be abandoned must fall into *Bovista* and not into *Scleroderma*, which differs in its thick, leathery peridium and different capillitium. If *Bovista pila* is to be placed in *Scleroderma* it is difficult to see why *B. nigrescens* and *B. plumbea* should not go there also. Nor is *Mycenastrum Ohiense*, E. & M., any more at home here, though it is not so easy to say just where it does properly belong, having, as it does, the sterile base of *Lycoperdon* with the capillitium of *Bovista*. I would leave *Bovista pila*, B. & C., where it is and make *Mycenastrum* a subgenus of *Bovista*, or if retained as a genus (which is perhaps preferable) restrict it to species with a spiny capillitium.

On page 53 of the volume cited we find another species to which several synonyms must be attached. (See S. Schulzer in Hedwigia, 1883, p. 43.) *Secotium Warnei*, Pk., *Columnaria*, Schulz., and *Secotium Thunii*. Schulz. are the same as *Secotium acuminatum* (Mont.) Tul.

This perhaps is not to be considered as a fault in the editor of the Sylloge, as this work aims only to give published descriptions; but without explanation one would suppose three distinct species where there is really but one.

Lycoperdon lepidophorum, E. & E., placed by Dr. De Toni in *Bovista*, we consider a good *Lycoperdon*, though not mentioned by Mr. Massee in his monograph of that genus. The deciduous scales correspond to the deciduous spines in some other species of *Lycoperdon* and are not to be considered as an outer peridium. The true peridium which is exposed when the outer scaly covering falls away is very thin and fragile and soon disappears.

SOME NEW SPECIES OF HYMENOMYCETOUS FUNGI.

By J. B. Ellis and Benj. M. Everhart.

Inocybe pallidipes, E. & E. (N. A. F. 2102.) On the ground, under filbert trees, September and October, 1887 and 1888.

Pileus conic-campanulate, about 1^{cm} high, finally expanding and umbonate, 2 to 3^{cm} across, light brown, fibrose-squamose, margin subrimose, disk innate-squamose or subrimose squamose. Lamellæ broadly attached with a strong decurrent tooth, ascending at first, then ventricose, scarcely crowded, rather broad (3^{mm}), pale, becoming light watery cin-

namon or clay color, margins lighter, and under the microscope fringed with cylindrical, obtuse, hair-like bodies (abortive cystidia?) Stem $2\frac{1}{4}$–5^{cm} high, 2–4^{mm} thick, subattenuated and farinose above, white, solid, loosely fibrillose below, sub-bulbous and white tomentose at base, faintly annular marked above the middle when young, but this is hardly discernible in the mature plant. Spores brown, inequilaterally elliptical, 7–8 by 4–5μ. Basidia clavate cylindrical, about 22 by 8μ, with sporophores about $3\frac{1}{2}\mu$ long. Cystidia ventricose-fusoid or flask-shaped, 40–45 by 14–16μ. The disk of the pileus is carnose, and in wet weather rimose-squamose.

Well marked by its conic campanulate pileus and *white stem*, which remains white till the plant withers.

This and the other species of *Inocybe* here described were all found at Newfield, N. J.

INOCYBE MURINO-LILACINUS, E. & E. (N. A. F. 1905.) On bare ground under chestnut and filbert trees, September to October.

Pileus convex, 2–4^{cm} diameter, umbonate-discoid, silky-fibrillose, at length becoming squamulose around the margin, umbonate-discoid in the center, mouse-color, with a tinge of lilac when fresh and young. Stem 2 2–4^{cm} high, 2–4^{mm} thick, fistulose and soon hollow. Spores narrow-elliptical, with an oblique apiculus, rust-color, 7–9 by 4–5μ. Basidia 22–25 by 7μ, clavate cylindrical.

The broad, prominent disk of the pileus either has a small umbo in the center or a slight depression and is generally surrounded (about half-way to the margin) with a distinct ridge or zone. The margin also projects slightly and is a little lighter colored, and, under the lens, subfimbriate.

INOCYBE CICATRICATUS, E. & E. (N. A. F., 1901.) In gravelly sand near filbert trees, August–October.

Pileus broadly and obtusely conical or conic-campanulate, expanding to convex, 2–$2\frac{1}{2}^{cm}$ across, densely gray fibrillose-rimose, except the smooth (livid when moist) disk. Flesh white, compact in the disk, almost disappearing towards the margin, which is a mere membrane. Lamellæ, ascending, narrowly attached, with a slight decurrent tooth, becoming sub sinuate, dirty white at first, becoming dirty cinnamon brown, 3–4^{mm} wide. Stem stout, short ($1\frac{1}{2}$–3^{cm}), 2–4^{mm} thick, sub-bulbous at base, solid, nearly white, and covered with a short tomentose-pubescent coat at first, finally darker and smoother and very often eaten out by worms so as to appear hollow and then easily splitting. Spores very irregular in shape, mostly longer than broad, 7–9 by 5–6μ. Cystidia broad-fusoid, 50–55 by 12–15μ.

This comes near *A. umbonionotus*, Pk., in the 38th report, but the pileus is not umbonate nor are the spores nodulose, but simply angular (subquadrate), as represented in his *A. maritimoides*, which again is said to be "densely squamulose with small, erect or squamose-fibrillose scales."

The disk has something the appearance of a scar; hence the specific name.

Inocybe echinocarpus, E. & E. (N. A. F., 1904.) On the ground in an old abandoned road among oak bushes, September–October.

Pileus conic-convex, not readily expanding, $1\frac{1}{2}$–2^{cm} across, pilose-squamose, disk broken up into stouter scales similar to those of *Hydnum imbricatum*, color tawny yellow. Lamellæ subventricose, rounded behind and narrowly attached or nearly free, scarcely crowded, dirty-pallid, becoming clouded by the ferruginous spores, margins whitish and nearly entire. Stem $2\frac{1}{2}^{cm}$ long, 2–3^{mm} thick, solid, of fibrous texture, tough (bends short without breaking), farinose-floccose above, sub-attenuated and slightly silky-fibrillose below, a little darker than the pileus. Spores *echinate* (not simply angular or tuberculose), but thickly beset with short spines, irregularly globose or a little elongated, 8–11μ, diameter on subventricose basidia about 30 by 10μ, with stout, slightly spreading sporophores 4–5μ long.

This is a well-marked species, easily recognized by its echinate spores, broad basidia, and coarsely squamulose disk. There is no sterile projecting margin to the pileus, the ventricose gills coming out full to the margin. The measurement of the spores includes the length of the projecting spines and is mostly 8–10μ, exceptionally 11μ. This differs from *A. stellatosporus*, Pk., in its larger *echinate* spores and stem not scaly.

Inocybe subdecurrens, E. & E. (N. A. F., 1906). On the ground under the overhanging branches of Norway spruce, September–November.

Densely gregarious. Pileus 4–5^{cm} across, convex, expanding to plane, with disk depressed and either umbonate or not, but oftener without any umbo, surface densely and evenly appressed-pilose, color yellow-drab, flesh thin. Lamellæ moderately close, adnate-decurrent, pale dirty cinnamon, not changing much in color with age, about 3^{mm} wide, margins serrulate. In the mature plant the lamellæ are very slightly ventricose, but never depressed around the stem. Stem mostly straight, sub-equal, *hollow*, fibrillose-squamose above, covered with loose white silky fibres below and white tomentose at base, 3–4^{cm} high, $\frac{1}{2}$–$\frac{3}{4}^{cm}$ thick, moderately tough. Spores elliptical, rounded at both ends, without any distinct apiculus, ferruginous cinnamon, 8–10 by 4–5μ on basidia, about 25 by 7–8μ. The stem is not simply fistulose, but in all mature specimens *hollow*.

This has been found in the same place in great abundance now for three years in succession.

Inocybe tomentosa, E. & E. (N. A. F., 2101). On the ground in grass, around and partly under the overhanging branches of Norway Spruces, at a short distance from the preceding species, but not mixed with it. July–September, 1888.

Gregarious and sub-cespitose. Pileus plano convex, depressed in the center and generally with a small umbo, 2–4^{cm} across, margin at first

incurved and connected with the stem by a loose, dirty white, cottony web, surface *appressed strigose-tomentose*, light-drab color becoming yellowish. Stem 2–3^{cm} high, 2–3^{mm} thick, solid or at least with only a slight cavity above, indistinctly annular-marked above the middle, surface loosely fibrose cottony, white tomentose at base. Lamellæ attached with a slight decurrent tooth, finally slightly depressed around the stem, pale at first, then dirty cinnamon, 3–4^{mm} wide, hardly crowded, margins subserrulate. Spores elliptical, slightly inequilateral, 6–8 by 4μ, dark rust color, on clavate-cylindrical basidia about 27 by 7μ with erect sporophores 3–4μ long. The surface of the pileus can not be called striate, though the loosely matted hairs all radiate from the center. Smell not farinaceous, rather unpleasant.

I. subdecurrens is larger, with a *hollow* stem, and has the gills more crowded, nor is the margin incurved and tomentose, and it is also of a rather darker shade and has the margin of the gills more strongly serrate.

In *I. tomentosa* the margin remains incurved till the plant is nearly full grown. In *I. subdecurrens* the margin is never incurved even when young, nor is there any annular mark on the stem though the fibrous veil is at first distinct. There does not seem to be any doubt that the two species are distinct, though their general appearance is much the same.

AGARICUS (HYPHOLOMA) OLIVÆSPORUS, E. & E. (N. A. F. 2009.) Among moss in swamps. Newfield, N. J., July, 1888.

Pileus 1½–2^{cm} across, convex, subumbonate, dark brick color when moist, lighter when dry, covered with a dense furfuraceous or mealy coat which soon disappears. Lamellæ free, rounded behind, nearly plane, unequal, chestnut-brown (at first purplish-violet or purplish-brown), becoming lighter when dry and more or less tinged with brick-red. Stem slender, 3–4^{cm} high, 1½–2^{mm} thick, more or less curved or bent, about the same color as the pileus, and like it furfuraceous at first, of fibrous texture, fistulose, the cavity loosely filled, rather brittle. Spores when fresh olive-brown, the green shade very distinct, elliptical, 3½–4 by 2μ. Basidia clavate, with the apex rounded, 15–20 by 6μ. Spores becoming umber-brown in drying. There is no sign of any annulus on the stem.

The pileus when young is sometimes brick color, but soon becomes grayish-buff, except the umbonate disk, which retains more or less of the reddish tint. The loose mealy covering of the pileus is very distinct and does not entirely disappear in the mature plant. The margin of the pileus is not involute, hardly incurved, and is at first connected with the stipe by a loose webby veil, which remains hanging to the margin as the pileus expands. The plant is sometimes sub-cespitose and often grows from pieces of wood buried in the soil.

Resembles *A. microsporus*, Ell., in general appearance, but that has *white spores* and the stem strigose below and rooting.

MUCRONOPORUS E. & E.

A NEW GENUS OF POPOLYPOREÆ.

In examining some specimens of *Polyporus* in our herbarium we find several species having the inner surface of the pores studded with reddish-brown spines exactly as in the hymenium of *Hymenochæte*. The only described species having this character, so far as we know, is *Polystictus balansæ*, Speg., of which Saccardo (in Syll.) remarks that it might well be the type of a new genus ("facile novum genus"). And in fact it is just as reasonable to separate the spiny-pores species under a new generic name as to separate *Hymenochæte* from *Stereum*. We therefore here propose to separate these species, which are mostly of the genus *Polystictus*, under the generic name of *Mucronoporus* (Mucro and porus.)

MUCRONOPORUS CIRCINATUS, (Fr.). Fine specimens of this species were found some years ago at Newfield, N. J., among the decaying roots of an old cedar stump. Spines abundant, more or less curved, 60–75 by 8–10μ.

MUCRONOPORUS DUALIS, (Pk.) (specimen from Peck.) has the same hooked spines as the preceding, and is probably a form of that species.

MUCRONOPORUS TOMENTOSUS, (Fr.). Specimens collected by Dr. J. Macoun on Prince Edward Island. Spines very distinct, ovate lanceolate at first, finally more slender 35–70 by 12–20μ.

On account of the spiny hymenium we at first supposed this to be a new species, but authentic specimens of *Pol. tomentosus* from Finland (ex Herb. Karsten) have the hymenium of the same character, and there can be no doubt that the Prince Edward Island specimens are that species. A drawing has been made of one of these specimens, and we add a brief description.

Centrally stipitate. Pileus orbicular, 6–12^{cm} across, thin, strongly depressed in the center, light dirty yellow, innate tomentose, mostly zoneless, but sometimes indistinctly zonate, margin paler. Flesh of pileus light yellow, of fibrous texture about 2^{mm} thick, subcoriaceous. Pores of medium size, about 2^{mm} deep, round or sub-angular, some of them compound, *i. e.*, divided below by partial dissepiments, margins thin, whitish, and sub-lacerate, umber color within. Stipe 1–3 by $\frac{1}{2}$–1^{cm} spongy, cinnamon color, minutely tomentose. The general appearance is that of *P. perennis*, but the pileus is of a brighter yellow and more distinctly tomentose, and the inner surface of the pores is studded with reddish brown ovate conical bodies 35–75 by 12–30μ, apparently of the same character as the bristles in *Hymenochæte*, only stouter. Plate VIII, figs. 1 and 2, show the upper and lower surface of the pileus. Fig. 3, section of pores, showing the projecting points or spines. Fig. 4, one of these spines magnified. Fig. 5, spine with a bifid tip.

MUCRONOPORUS GILVUS, (SCHW.). In all the specimens of this species the spines are present but not abundant. They project 15-20μ and are about 4–5μ thick at the base.

MUCRONOPORUS ISIDIOIDES, (BERK.). The specimens of this species in de Thümen's Mycotheca 1105, from South Africa, as well as those from Ohio (ex herb. Berk.), have spines of the same appearance as in the specimens of *P. gilvus*, and this is another indication that this so-called species is only a form of *P. gilvus*.

MUCRONOPORUS SETIPORUS, (BERK.). (Specimens from Ceylon, com. Cooke.)

Spines 25–30 by 4μ.

MUCRONOPORUS LICNOIDES, (MONT.). (Specimens from Brazil, com. Cooke.)

Spines abundant, rather short, 15–20μ.

MUCRONOPORUS CICHORIACEUS, (BERK.). (From Australia, com. Cooke.)

Spines quite abundant, projecting 25–35μ long, and about 5μ thick at the base.

MUCRONOPORUS TABACINUS, (MONT.). (From New Zealand, com. Cooke.)

Spines more abundant than in the specimens collected by Dr. Martin in Florida and distributed in N. A. F. 1705.

MUCRONOPORUS SPONGIA, (FR.). (Specimen from Cooke.)

Spines 20–25 by 6–8μ, curved like the spines on a rose bush.

MUCRONOPORUS CROCATUS, (FR.). (Specimens in Rav. F. Am. 707 and 708.)

Spines 25–30 by 4–5μ.

MUCRONOPORUS BALANSÆ, (SPEG.).

Fungi Guaranitici Pugill. I. No. 42. Spines 20–25 by 5–6μ.

In the measurement of the spines we have given the length of the projecting part. The base of the spines penetrates more or less deeply into the hymenial layer of the pores, and if this is included the length will be somewhat greater.

TRIBLIDIUM RUFULUM (SPRENZEL).

By J. B. ELLIS.

This appears to be a variable species. The specimens in Rav. Fungi Car. Exsicc. II, No. 47, have the sporidia oblong, slightly curved, nearly opaque, 3-septate, 24–30 by 10–12μ, very slightly or not at all constricted at the septa. Specimens found by Mr. Langlois (No. 130) on dead fig tree in Plaquemines Parish, La., agree with Ravenel's Carolina specimens, unless in having the sporidia a little more constricted. In the specimens from both these localities the hymenium is of a deep *brick-red* color and the lips are slightly transversely striate. Specimens collected at Ocean Springs, Miss., in February, 1887, by Mr. F. S. Earle (No. 202), agree with the Carolina and Louisiana specimens in all respects except in having the sporidia only 1-septate and a little smaller

(18–22 by 8–10μ). We have designated this as var. *simplex*, E. & E. Specimens found by Col. W. W. Calkins near Jacksonville, Fla., January, 1889, have the 3 septate (24–30 by 10–12μ) sporidia of the Carolina and Louisiana specimens, but the hymenium is *slate* color, the perithecia cespitose (they are scattered in all the others), and the lips very distinctly striate. We have called this var. *fuscum*, E. & E.

BRIEF NOTES ON A FEW COMMON FUNGI OF MONTANA.

By W. F. Anderson.

Claviceps purpurea, said to be comparatively rare in many Eastern States, is found everywhere in the Territory. I have found it on four species of *Elymus*, on three species of *Poa*, on six species of *Agropyrum* as well as on *Kœleria cristata*, *Phalaris arundinacea*, and several other grasses. The little rye grown is not materially injured by the *Claviceps*. I have collected this fungus at 8,000 feet altitude; it is as common at that height as at 3,000 feet—the general average of Montana's plains above sea level.

Some years the loss to stock-men from the abortions of cows and mares is heavy. Many claim that losses from this cause are greater in seasons when an unusual abundance of ergot is developed on the grasses; but there are others who scout this idea. However, whether the eating of ergot in considerable quantity by stock has an irritating influence on the internal genitals or no, it is certain that the general health of the animals is impaired thereby.

Ustilago caricis is remarkably plentiful, pretty regularly every other year. Whether it is a baneful fungus to the health of stock I am not prepared to say. It is at any rate seriously injurious to three small but important forage plants, viz: *Carex filifolia*, *Carex stenophylla*, and *Carex Douglasii*. These sedges, especially the first, comprise a considerable proportion of the "grass" on the plains, and are eagerly eaten by stock. In April they are in flower and by the 1st of May their fruit is more or less fully developed. Diseased spikes are very conspicuous in the immature stage of the fungus by the round lead colored balls attached to them. Later this lead-colored coat breaks, and the intensely black spores are seen to cover the balls. Stock avoid plants in this condition.

Ustilago segetum as yet is not seriously injurious to cultivated cereals. It is rather common, however, on the weed *Hordeum jubatum*.

Ustilago minima is common on *Stipa comata*. It destroys the panicle almost entirely. In autumn the bare blackened rachis breaks out of the sheath and curves outward and downward, almost touching the ground.

Another *Ustilago* which bids fair to do considerable damage to *Muhlenbergia* as soon as that grass is cultivated as a regular crop is the new

Ustilago Montaniensis Ellis & Holway, on *Muhlenbergia glomerata* var. *setiformis*, first discovered by the writer December 12, 1887. This appears to be one of the most destructive species of *Ustilago* we have. The host plant begins to "head out" when it is 3 inches high. These early panicles are lateral, and smaller than the final terminal panicle, which, under favorable conditions, is developed by the time the plant is 24 or 30 inches high. Culms affected by the fungus are generally stunted and thickened, becoming harsh and knotty. Their panicles are usually aborted from first to last. Sometimes only the lower or middle spikelets in the dense spikes are infected, the rest being perfect and producing seed. In the case of the small lateral panicles, which are mostly smutted entirely, the panicles do not grow out of the sheaths, but are inclosed by the united and membranous bases of the sheathing leaves. As the fungus develops this usually cylindrical or oblong sac enlarges and gradually loses its leaf character, except where its two parts extend above and beyond the inclosed panicle. The membrane surrounding the smut has by this time become a leaden-gray color, and exceedingly thin and chartaceous. Where only more or less isolated small spikes and spikelets of a panicle are affected, the surrounding membrane is formed by the uniting of the glumes, which are free and maintain their true character only at their tips.

Three times out of five if the fungus is present it affects all the panicles. When the very first one appears in an infected plant it will be found full of smut, and each succeeding panicle as it is developed will be found to be in a similar condition, so that it is evident the fungus develops with the host. The host is a perennial, and so far as I have been able to discover by examining old and new culms, representing four years' growth, the plant once attacked is affected each succeeding year until its death. As *Muhlenbergia* is a valuable grass and will soon be common in cultivation, this fungus ought to receive careful attention.

Erysiphe graminis is a common pest in some sections, notably in southern Montana, west of the main divide of the Rocky Mountains. It affects chiefly the *Poas* and is especially damaging to *Poa tenuifolia*, one of our most valued forage grasses. The asci of the fungus contain ripe spores in November.

Puccinia rubigo-vera is common everywhere. I have collected it on fourteen species of native grasses. It is most damaging to *Elymus condensatus*. Wheat and oats do not suffer from it as yet.

Puccinia tanaceti occurs on many hosts. The cultivated Sunflower is sometimes ruined by this fungus. The common Sage-brush (*Artemisia tridentata*) is frequently attacked so overwhelmingly by *Puccinia tanaceti* that its flowers dry up and its leaves fall off. The fungus attacks the younger stems and shoots, blackening them also. I have found it on five species of *Artemisia*, viz: *A. tridentata*, *A. cana*, *A. Ludoviciana*, *A. frigida*, and *A. dracunculoides*. On *A. dracunculoides* and *A. Ludoviciana* I have found one of the numerous *Æcidium com-*

positarum forms occurring with the uredo of *Puccinia tanaceti*, closely followed by the teleutospores. The same *Æcidium* occurs on all five, and is invariably followed, if not accompanied, by the uredo and teleutospores of this fungus.

PHRAGMIDIUM SUBCORTICIUM occurs, sometimes to an alarming extent, on *Rosa Arkansana*, *Rosa blanda* (?), and *Rosa Sayi*. No doubt it would do serious damage to cultivated roses in certain localities. At Helena in 1887 I found several cultivated varieties more or less affected by the *æcidium* of this fungus. On the wild roses the uredo and teleutospores do serious injury, some years destroying the leaves.

MELAMPSORA SALICIS is found on nearly all our Willows. I have found it abundantly on *Salix longifolia*, *S. cordata*, *S. amygdaloides*, *S. rostrata*, *S. flavescens*, and *S. glauca*. It appears to be most injurious to *Salix cordata* and *Salix flavescens*. Sometimes in the early fall great clouds of the red uredospores are blown from the trees, sprinkling the vegetation for some distance around. Last year this *Melampsora* was unusually prevalent and vigorous in its attacks. I found it both sides of the main divide of the Rocky Mountains, from the southern border of the Territory and the source of Clarke's Fork of the Columbia River and the source of the Missouri River, thence northeastward to within fifty miles of the Canadian line. Good sized trees in some localities were almost entirely defoliated. On the banks of the Upper Missouri, in one locality, were found in September several hundred acres of seedlings of *Salix amygdaloides* and *Salix cordata*, then from 3 to 6 inches high and as close as grass, which were probably permanently ruined by the uredo of *Melampsora salicis*. The leaves, especially the lower ones, had all fallen from the effect of the parasite and were decaying. The upper leaves were almost devoid of chlorophyll and evidently perishing.

MELAMPSORA POPULINA, like the last, was very abundant last year and did considerable damage to *Populus tremuloides* and *P. angustifolia*. I also found it on *P. monilifera*, *P. balsamifera*, and *P. angulata* more sparingly.

MELAMPSORA LINI some seasons is ruinous to *Linum rigidum*, and also sharply attacks *Linum Lewisii* (commonly called *L. perenne* by western collectors). *Linum Lewisii* is rather similar to the cultivated flax, and if the latter were introduced it would doubtless suffer more or less from this fungus.

SPOTTING OF PEACHES.

By ERWIN F. SMITH.

A recent paper on this subject by Dr. J. C. Arthur (Bull. Agr. Exp. Sta., Indiana, No. 19, 1889) leads to the following remarks:

Cladosporium carpophilum, v. Thümen is undoubtedly the conidial stage of some well-known ascomycetous fungus. It occurs on the leaves

as well as the fruit, and I think also on the branches. It is by no means confined to Indiana, or rare in any peach district in the United States. It is common along the Atlantic, in the region of the Great Lakes, in the Lower Mississippi Valley, and in California. In Maryland and Delaware it has been known for many years, and is so abundant that its presence is regarded as a matter of course. The choice early peaches and the middle varieties are little subject to it, but Smocks and nearly all late and inferior sorts are more or less spotted. So constant is this spotting that many peach-growers have come to consider it as *characteristic* of certain varieties and have no idea that it is abnormal.

It injures the appearance of the fruit somewhat, and when very abundant the flavor also, unless I have been much deceived. Growers do not generally regard it as a serious evil, or indeed as a matter of any consequence. The loss in late sorts with firm flesh is nevertheless sometimes very considerable. So far as my own observation goes this results principally from cracking and rot, in much the same way as in apples and pears when badly attacked by *Fusicladium*. The half-grown peach forms a protective layer of cork beneath the most thickly spotted surface. This cork layer is incapable of further growth and is ruptured in deep irregular fissures when the peach rapidly enlarges during the last few days of its growth. The spores of *Monilia fructigena* Pers. fall upon this exposed surface and rot begins immediately. The cracking appears to be worse in rainy weather, which is also the most favorable condition for the rapid development of the rot. In September, 1888, in the great peach region of Maryland and Delaware (the north part of the peninsula) fully one-half of the Smock peaches, aggregating many thousand baskets, were lost by rot during a rainy week. Cracking of the fruit often preceded this rot and was due in part to *Cladosporium*. Nevertheless the loss would have been inconsiderable but for the presence of this other much worse parasite—the rot fungus.

In 1886 and 1887, two very rainy seasons *Cladosporium carpophilum* was abundant in Maryland and Delaware, and I am therefore inclined to think that dry seasons are not specially favorable to its growth.

EXPERIMENTS IN THE TREATMENT OF GOOSEBERRY MILDEW AND APPLE SCAB.

Prof. E. S. Goff, of the New York Experiment Station, has kindly furnished us with the results of his experiments in the treatment of these diseases in 1888, which we give in full below:

POTASSIUM SULPHIDE FOR THE GOOSEBERRY MILDEW.

At the suggestion of Dr. J. C. Arthur,* formerly botanist to the

* For results secured with this substance by Dr. Arthur in 1887, see Report New York Agricultural Experiment Station, 1887, pp. 248-252.

station, a series of trials was made with potassium sulphide (liver of sulphur) as a preventive of injury from the disease of the gooseberry plant commonly known as "mildew," and due to a fungus parasite known to science as *Sphærotheca mors-uvæ* B. & C. The substance was applied in solution at the rate of one-half and one-fourth ounce to the gallon, respectively, commencing May 3, or as soon as the leaves had begun to expand, and the application was repeated after every hard rain until June 24, nine sprayings having been made in all. The experiment was made upon a row of the Industry gooseberry containing five plants, and upon a plat of seedlings numbering 282 plants.

Toward midsummer the effect of the spraying became distinctly visible in the deeper green foliage and more rapid growth of the treated plants. On June 23 the two plants of the Industry gooseberry that received the sprayings were noted as being entirely free from mildew, with the exception of a trace of it observed on a single fruit, while the three not treated were quite badly affected. The fungus appeared as a downy coating near the ends of the new shoots, and also upon the berries. The new growth, as well as the crop of fruit, was very perceptibly greater on the treated plants. At this time the bed of seedlings had not been perceptibly attacked by the fungus.

On July 16, the seedling plants were found to be considerably affected, and an examination showed that in the row treated with the sulphide at the rate of half an ounce to the gallon, only one plant exhibited signs of mildew out of a total of 60—about 1.7 per cent; in the row treated at the rate of one-fourth ounce to the gallon 3 plants were affected out of 43—about 7 per cent.; while in 133 plants not treated, 15 were affected, or about 11.3 per cent.

As these plants were all seedlings from native varieties and are not all subject to mildew, these figures are only an indication of the effects of the treatment and not a proof, for I do not know how many plants in the treated rows would have been affected had the applications not been made. There could be no question, however, as to the benefits resulting from the treatment. As far as the plantation could be seen the sprayed rows were conspicuous for the richer green of their foliage; and the row receiving the stronger solution showed somewhat greater vigor than the other. A part of this benefit, however, probably resulted from the influence of the sulphide in destroying or repelling the currant worm, as the treated plants were noticeably less injured by this insect than the others. A part also may have resulted from the fertilizing effect of the potash applied.

In the latter part of summer, after the spraying had been discontinued, the mildew increased on the treated plants, showing clearly that the applications were beneficial, and also that they must be continued throughout the growing season to confer their greatest benefit.

SODA HYPOSULPHITE CONTRASTED WITH POTASSIUM SULPHIDE AND CALCIUM SULPHIDE FOR THE APPLE SCAB.

In former reports are given the results of experiments with soda hyposulphite for the apple scab, *Fusicladium dendriticum*, Fckl. From these it appears conclusively that this substance as used acted beneficially, but that it was not a complete remedy for this disease. It is very desirable that some substance be found that will prove more effectual in destroying this fungus without causing greater harm to the foliage. Two other compounds of sulphur, viz, potassium sulphide and calcium sulphide, were therefore tested the past season. The first trial was made with the potassium sulphide in solution, at the rate of half an ounce to the gallon, upon the crab-apple tree treated for three seasons preceding with soda hyposulphite, as described in the experiments cited.

The spraying, which was done with the so-called Little Gem force-pump, fitted with a "Climax" nozzle, was made upon the west half of the tree only, and was commenced May 10, just as the leaves were expanding, and repeated after every hard rain until July 24, eight applications having been made in all.

The tree blossomed alike, apparently, on both the sprayed and unsprayed portions, but the crop of fruit matured was much larger on the sprayed part, and, as the following figures will show, was of much better quality.

On September 12 a quantity of fruit was picked from the sprayed and from the unsprayed parts of the tree, and each lot assorted into three classes, in order to determine their relative injury from the disease. In the first quality were put only fruits nearly or quite free from scab; in the second those that were considerably scabby, but not so much as to distort their form or prevent them from acquiring their normal size, and in the third those which were distorted in form or diminished in size by the growth of the fungus.* The results secured as follows:

	Number of fruits examined.	Per cent. in first quality.	Per cent. in second quality.	Per cent. in third quality.
Sprayed part	1,560	75.9	22.6	1.5
Unsprayed part	627	46.9	45.3	7.8

More than 627 fruits did not mature on the unsprayed part of the tree. On the sprayed part, however, many more might have been gath-

* This classification is necessarily somewhat arbitrary, but, as the assorting was done with care, it is believed that the figures represent the true proportions of the amount of injury wrought by the scab. Almost all the fruits were somewhat scabby in the cavity about the stem, but if not affected elsewhere, this did not exclude them from the first quality.

ered. If we ascribe the larger crop on the sprayed part to the influence of the application, it is evident that the figures express but a small part of the benefit resulting from the treatment. Aside from the difference in crop, the fruits on the unsprayed portion were inferior in size to those on the other part.

A comparison of the results secured the past season with potassium sulphide with those secured on the same tree in 1885 and 1887 with soda hyposulphite would indicate that the former proved the more effectual. Such a comparison, however, may not be just.

In a second trial, ten trees of the Fall Pippin apple were treated as above described, with solutions of three compounds of sulphur, viz: Soda hyposulphite, at the rate of half an ounce to 10 gallons; potassium sulphide, half an ounce to the gallon; and calcium sulphide in a saturated solution, the spraying in every case being made on the same day and in the same manner. The trees were divided into three series, the second, fifth, and ninth forming the second, and the third, sixth, and tenth the third series. The first sprayings were given June 5, by which time the leaves were well expanded. Other sprayings were made June 16, June 27, and July 2, each of which shortly succeeded a hard rain.

On September 21 the fruits on the sprayed and unsprayed portions of each of the ten trees were picked, with the exception of a belt about 3 feet wide across the center of the trees where the sprayed and unsprayed parts were supposed to meet. The apples were then assorted into three qualities, as described in the case of the crab apple tree, with the following results:

	Number of fruits examined.	Per cent. in first quality.	Per cent. in second quality.	Per cent. in third quality.
First series—Soda hyposulphite:				
Sprayed part	495	56.56	27.91	16.43
Unsprayed part	397	46.85	27.96	25.19
Per cent. in favor of sprayed part	....	9.71	....	8.76
Second series—Potassium sulphide:				
Sprayed part	960	31.35	40.11	28.54
Unsprayed part	247	22.67	36.03	41.30
Per cent. in favor of sprayed part	....	8.68	....	12.76
Third series—Calcium sulphide:				
Sprayed part	315	28.26	40.95	30.79
Unsprayed part	129	37.21	33.33	29.46
Per cent. in favor of unsprayed part	....	8.95	....	.67

From this trial it does not appear that the potassium sulphide was decidedly more effectual than the soda hyposulphite, although as applied it contained about fifteen times as much sulphur. The soda hyposulphite injured the foliage somewhat, and evidently could not be safely used in a stronger solution.

The calcium sulphide apparently did no good whatever. This substance is only very sparingly soluble in cold water, which may account

for its inaction. The fact that the sprayed part, when treated with this substance, showed so much greater percentage of injury than the unsprayed throws a possible doubt over the whole trial, for we can not suppose that this compound of sulphur could have favored the growth of the fungus.

The results of these tests appear to warrant the following conclusions:

First. That soda hyposulphite and potassium sulphide, as applied, proved beneficial in preventing injury from the fungus. This conclusion is strengthened by the results secured in previous experiments already cited.

Second. The tests do not prove that the greater amount of sulphur added in the potassium sulphide as compared with the soda hyposulphite rendered this substance the more effectual, though there are indications in this direction.

Third. That calcium sulphide is of little or no value for the purpose used.

Fourth. That while further experiments are needed to furnish data from which we may compute the actual benefits conferred by the treatments, the indications are that the good accomplished was sufficient to warrant the slight cost of the materials in the case of orchardists who spray their trees for the codling moth.

NOTES.

By B. T. Galloway.

SULPHURET OF POTASSIUM FOR BITTER ROT OF THE APPLE.

Judging from the reports received bitter-rot of apples (*Glœosporium fructigenum*) is on the increase. Last year (1888) Mr. J. W. Beach, of Batavia, Ark., made some experiments with the view of finding a remedy for this disease which are not without interest. We wrote Mr. Beach early in March, 1888, requesting him to spray the fruit five or six times during the season with a solution of sulphuret of potassium, one-half an ounce of the potassium to the gallon of water. In accordance with our instructions the first application was made when the apples were about one inch in diameter, and the Lewis Combination Force Pump was used for the purpose. The second application was made three weeks later, and was followed by a third in about a month. Up to the time of the third application very little rot had appeared on the sprayed apples, while those not sprayed rotted badly. Unfortunately at this time the supply of the fungicide became exhausted and nearly two months elapsed before enough was obtained to make the fourth application. During this interval much of the sprayed fruit which had hitherto remained healthy fell a prey to the disease, and, in spite of all treatment, this continued until the fruit was harvested. Mr. Beach, however, has full confidence in the remedy and says that during the

coming season "every precaution will be taken to apply it in *advance of the fungus.*"

This last statement is the key to success in the treatment of all fungous parasites. The treatments must be made before infection has taken place.

BORDEAUX MIXTURE FOR THE PLUM LEAF-BLIGHT.

In many parts of the South and West peach and plum trees suffer from the attacks of a parasitic fungus (*Puccinia pruni-spinosa*) belonging to the rust family. This fungus attacks the leaves, causing them to fall long before the proper season. During the summer and autumn of 1888 Prof. T. L. Brunk, at our suggestion, conducted a series of experiments at the Texas Agricultural College with the view of finding a remedy for this pest. Professor Brunk writes as follows concerning the results of his experiments:

> I am greatly encouraged by our experiments with the Bordeaux mixture sprayed upon two rows of trees August 21 last. Two rows which alternated with three others that were carefully and thoroughly pruned last winter were selected for the spraying. On October 5 the plants were examined and it was found that those not treated had lost nearly all of their foliage, while those sprayed had lost only a very small per cent.

Professor Brunk concludes as follows:

> At this writing (October 30) the difference in the treated and untreated trees is very marked. Those that were sprayed have yet about two-fifths of their leaves, while the alternating check-rows are nearly leafless. We intend to begin in the spring next year, and I believe that if the trees are syrayed about three times during the growing season—the first when the fruit is setting, the second about a month later, and the third in August, or after the fruit is picked—that the fungus will cause little injury.

A TOMATO DISEASE.

Of late years Mr. Marcius Wilson, of Vineland, N. J., has had considerable trouble with a fungus which attacks his tomatoes, especially those grown under glass. It appears on the leaves and young shoots at any time during the winter, and often kills them outright or greatly injures their vitality. From specimens communicated by Mr. Wilson it was learned that the disease was caused by *Cladosporium fulvum*, a fungus which has occasioned considerable injury in England.

According to Col. A. W. Pearson, Mr. Wilson has succeeded this year in completely holding this fungus in check by the use of the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime to 22 gallons of water. The first application was made in December, while the plants were yet apparently healthy. For applying the remedy the Eureka Sprayer was used, and it answered the purpose "admirably."

REVIEWS OF RECENT LITERATURE.

WORONIN, Dr. M. *Ueber die Sclerotienkrankheit der Vaccinen-Beeren.* Entwickelungsgeschichte der diese Krankheit verursachenden Sclerotinien, mit 10 Tafeln. Mémoires de l'Académie impériale des Sciences de St. Pétersbourg, VII. Sér., Tome XXXVI, No. 6., Prix: 6 m.

The *Sclerotium diseases of Vaccinium berries* is the title of a new German work by Dr. M. Woronin, which forms one of the memoirs of the Royal Academy of Sciences of St. Petersburg.

Four species of *Sclerotinia*, each attacking a different species of Vaccinium are described and illstrated. The species and hosts are (1) *Sclerotinia vaccinii*, Wor. on *V. Vitis Idæa;* (2) *S. oxycocci*, Wor. on *V. oxycoccus;* (3) *S. baccarum*, Schr. on *V. myrtillus;* and (4) *S. megalospora*, Wor. on *V. uliginosum.*

The first named species is described in detail, and the following abstract consists mainly of the author's own summary.

Sclerotium vaccinii is a true parasite, which, however, leaves its host when the Sclerotium is mature, in order to develop itself farther at the expense of the reserve material which it has already appropriated.

The gonidial stage appears in the spring upon leaves and stems of the new shoots of the Cowberry, in the form of a dense, powdery, mold-like coating which emits a strong, pleasant, almond odor. On the stem the fungus usually appears near the end and only on one side, causing the branch to bend so that the fungus comes on the under concave side. The disease proceeds from the stem into the leaves, the bases of which become discolored. In the stem the greatest injury is caused to the cambium layer, which shrivels up and separates from the wood. In the outer bark tissues between the decaying cells is formed a pseudo-parenchymatic cushion from which simple or often dichotomously branched hyphæ break out through the cuticle. These hyphæ are at first beaded and continuous, but later double septa appear at the constrictions. In the center of these septa is cut out a spindle-shaped piece of cellulose, the "disjunctor," which serves the purpose of separating the gonidia at maturity. The ends of the gonidia are at first incurved around these pieces, but when they separate the ends push out, making the gonidia lemon-shaped. The septa form parts of what the author calls the "primary membrane" of the spores, which forms just within the common cell-wall of the original beaded hypha.

The ripe, separated gonidia germinate very differently according to the medium in which they happen to be placed. In perfectly pure water the surface of the gonidium becomes covered with small, round spermatia-like sporidia, which are incapable of germination. In slightly impure water the gonidia put out short hyphæ, which in turn produce

and cut off these small bodies on all sides. In fresh juice pressed from a ripe plum the gonidia grow into branched, many-celled germ tubes, whose cells at once swell up into large spheres and easily anastomose. Finally, in plum and raisin decoction the gonidia produce long, separate, often anastomosing branched hyphæ, which when transferred into pure water again produce the globose sporidia, although they do not do so in the other media.

These gonidia are carried by the wind to the stigmas of the *Vaccinium* flowers, where they germinate. The germ tubes follow the path of the pollen tube, grow down into the ovary, and there develop into a sclerotium-forming mycelium. The cells of the ovary first become filled with a sclerotium-like mass, and the ends of the hyphæ form a palisade-like layer against the ovary wall. Later branches of the hyphæ break through into this wall and form a sclerotium there also. In the mean time some of the central portion has disappeared, so that the complete mature sclerotium is hollow and is composed of two layers, the inner one consisting of the palisade portion of the mass within the ovary cells, and the outer of the pericarp permeated by the fungous mass.

A sclerotium finally develops in every infected berry. Instead of ripening,the berries become dark colored, fall from the plant at the end of the summer, and remain under the snow without any noticeable change through the winter.

In the spring, just after the melting of the snow, primordia are produced somewhat below the rind of the outer layer. These do not always develop farther, more than one of them growing out into chestnut-brown, long-pedicelled, cup fruits only in occasional instances.

The apothecia are bell-shaped at first, later they are plate-like, and finally the edge sometimes turns downward. When the cup is fully formed a shaggy tuft of rhizoids grow out from the base of the stem; they serve the plant not only as a support but as an organ for obtaining nourishment.

The hymenium is composed of paraphyses and asci, the latter being formed from the primordia themselves and the former from outgrowths of the cells of the outer layer of the sclerotium. The paraphyses are fine, simple or dichotomously branched, septate hyphæ, whose upper free ends are slightly club-shaped and surrounded by a brown balsam-like mass. The asci always contain eight ascospores of nearly uniform size, all capable of germination.

Like the gonidia, the ascospores germinate differently according to the substratum in which they are sown. In pure water they also cut off small, globose, spermatia-like sporidia from their sides. In a plum decoction they grow out into long, irregularly formed threads, and swollen spherical protuberances. In a decoction of fresh leaves and young stems of the Cowberry the ascospores put out one or several fine germ tubes, between which and the globose sporidia almost all the intermediate stages can be found.

The ascospores infect the unfolding shoots of the Cowberry in the spring, about the end of May or beginning of June. At the point of contact with the host plant an ascospore puts out one, occasionally two, slender germ tubes, which never penetrate through a stoma but bore between two adjacent epidermal cells or directly through one of these into the host plant.

The germ tubes which are produced by the ascospores seek the fibro-vascular bundles of the host plant, and continue their growth from these bundles as a centre, thus reversing the direction of the fungus so that it grows from the center of the plant toward the periphery. Then appears a most peculiar phenomenon; the fungus exerts an injurious influence on the surrounding tissues of the host plant, killing them first and then using them as food for its further development.

Finally the hyphæ penetrate between the elements of the outer rind, which has been killed by the fungus, and there develop into a large-celled, pseudo-parenchymatic, stroma-like cushion, from which the gonidia chains grow into the air through the ruptured cuticle.

The other three species are dealt with much more briefly, since their general characteristics are much the same as the first one. In the chapters devoted to them the author deals mainly with the features which distinguish them as distinct species and wherein they differ from the first.

He suggests that the second species which attacks the small cranberry, *Vaccinium oxycoccus*, may be the same one that attacks the American cranberry, *V. macrocarpon*, and if this is true says that the matter of routing the disease is an easy one, viz, collecting and burning all the diseased berries in the fall. To one acquainted with the manner and places of growth of American cranberry vines this method might present some practical difficulties.

In conclusion there are a few notes on other forms.

He found the gonidia and a sclerotium like condition of *Acrosporium cerasi*, Rabh., which occurs on the cherry. On *Prunus padus* he found a fungus having the three forms, gonidia, sclerotia, and apothecia, and analogous forms were observed on *Sorbus acuparia*. He is also of the opinion that the well-known *Monilia fructigena* is only the gonidial form of a similar Sclerotium. He has found Sclerotia in the fruit of *Alnus* and *Betula*, and in the latter case has seen a cup fruit grow from the Sclerotia in the spring.

The work is a valuable contribution to our knowledge of the life histories of the *Sclerotiniæ*, and the author's name is sufficient authority for its perfect reliability. The illustrations are particularly fine, and it is a deplorable fact that very few American works can point to similar ones.—Effie A. Southworth.

JENSEN, J. L. Journal of the Royal Agricultural Society of England, Vol. XXIV., Part II. *The propagation and prevention of smut in oats and barley.*

This is the title of a paper which has been reprinted in pamphlet form from the journal of the Royal Agricultural Society of England. The paper is full of practical ideas, many of which are comparatively new, and deserves careful attention by all grain-growers.

The paper is divided into three parts: A. Propagation of smut; B. Varieties of smut; C. Prevention of smut. Under the first head Mr. Jensen states (1) The spores of smut falling on the ground during the summer will not to any appreciable degree affect barley and oats grown in that field in the ensuing season. (2) The spores of smut in farm-yard manure, when applied to the field, will not to any appreciable extent affect oats and barley. (3) Spores of smut adhering externally to the seed of barley and oats are unable, to any appreciable degree, to infect the crop produced from that seed. (4) Although, as is shown by the foregoing, it is impossible to infect oats and barley with smut spores to any appreciable extent by applying them to the seed, yet there can be no doubt that the spores are the reproductive bodies of the fungus by which smut is propagated in nature.

The first three statements are supported by statistics of experiments in which seed was sown in soil containing smut spores, in heavily manured soil, and with spores dusted on the outside of the *seed; in no case was there an appreciable increase in the amount of smut.* Under 4, Mr. Jensen attempts to answer the question, "In what manner does the propagation of smut take place?" His experiments led him to the following solution of the question: Infection takes place by means of spores which, having gained admission within the husk, remain there quiescent until the grain germinates.

Under B is given the results of experiments to determine whether or not the smut which affects barley, oats, and wheat are the same species. The author concludes from these trials that if these smuts are not different species they are at least well marked varieties. He further remarks that to the farmer this information is of importance, as there is no fear of adjacent fields sown with different crops infecting one another; a smutted barley field, for instance, will not infect a field of oats, or *vice versa.*

C. *Prevention of smut.*—The various dressings, such as sulphate of copper in solution, solution of sulphate of copper with quicklime applied about twelve hours afterward, sulphuric acid and water, quicklime with or without subsequent treatment with common salt are first enumerated under this heading. The author then gives the results of his experiments with these preparations as well as with several methods of his own conception, which consisted in exposing the grain to dry and moist heat, also soaking it in water ranging in temperature from 123° to 133° Fahr.

Concerning the action of sulphate of copper (bluestone) Mr. Jensen says that one-fourth per cent. of this salt reduced the per cent. of smutted heads to such an extent that it might be considered practically sufficient. A part of the seed-crop was killed, however, and the crop suffered not inconsiderably. With a 1 per cent. solution about three-fourths of the seed was killed, and a large number of plants remained without rootlets for two or three weeks. This lot was still green when all the others were almost ripe. The remaining experiments demonstrated beyond question that the seed in many cases was destroyed or its vitality was greatly injured by dressing with the preparations enumerated above; they moreover showed that disinfection by heat was the safest and most satisfactory way of treating the grain. The author concludes his remarks on this subject as follows:

> Dressing cereals with sulphate of copper in the usual manner against smut and bunt causes, as a rule, a waste of seed. It is, moreover, injurious to the plants and is unnecessary. Treating the seed with water heated to a temperature of 127° Fahr. for five minutes prevents these diseases equally well and protects barley much better, while it has the advantage of not injuring the seed or the resulting crop.—B. T. GALLOWAY.

KELLERMAN, W. A. Experiment Station, Kansas State Agricultural College. Bulletin No. 5, Dec., 1888. *Preliminary Report on Sorghum Blight.*

The paper describes the appearance of the disease, and gives briefly the results of the laboratory experiments, which were performed by W. T. Swingle.

Plants were examined first with reference to the disease being caused by insects and the theory disproved.

The most common and evident appearance of the disease is in large blotches on the leaves. The roots were examined and found to be diseased also, often to such an extent as to be entirely destroyed, and in this case the stem at the junction of the roots was also diseased; in other cases the stem was intact, except where it had been wounded.

The microscopic examinations resulted in proving the disease to be the work of a micro-organism, the *Bacillus sorghi*, belonging to the group of *Bacteria*. The presence of the germ was demonstrated by the microscope, and the disease was produced on young and apparently healthy plants by inoculating them with a broth containing the organisms.

Sorghum seed was planted at the same time in soil taken from a field of diseased plants and in soil from the greenhouse. The plants which were produced in the former were all badly diseased, and those in the latter not at all or only slightly.

He concludes (1) that it is not wise to use a field in which the disease has been present even in a mild form the year before; (2) when the crop is infected, not even the stubble should be plowed under but collected and burned.

A list of varieties which are free from or subject to attack is also given. The paper is one of great practical value to sorghum growers.—EFFIE A. SOUTHWORTH.

MASSEE, GEORGE. *On the presence of sexual organs in Æcidium.* Annals of Botany, Vol. II, No. V, p. 47.

There has been much speculation among botanists as to the occurrence of antheridia and oögonia in the *Uredineæ.* The question now seems in a fair way to be settled in the affirmative.

In *Annals of Botany* for June, 1888, George Massee, of Kew, contributes an interesting illustrated paper, going to show that a distinct sexual process precedes the formation of Æcidia in this important group of plants. His discovery was made in the spring of 1888, while examining the æcidial form of *Uromyces Poæ*, Rab., which form occurs abundantly at Kew on *Ranunculus Ficaria.*

He describes and illustrates several stages. Fig. 1 shows a clavate body surrounded by a weft of hyphæ. This body, rich in granular protoplasm, was under observation some days, during which its size increased and its contents became less granular. Several refractive globules also appeared, and a nucleus was demonstrated by use of methyl-green. Fig. 2 shows an irregular oblong body much larger than Fig. 1, but otherwise resembling it; and a much narrower, curved, and blunt-pointed antheridial body arising from a distinct mycelial thread and attached by its end to the side of the oogonium. Its exact connection with the latter was not made out. Both organs are full of densely granular protoplasm, and each is separated from its hypha by a septum. By keeping this slide in water with 2 per cent. of glycerine the development of these organs was followed for two days. During this time the antheridium became empty and shriveled, while the oogonium continued densely protoplasmic, increased in size, and became somewhat pear-shaped—Fig. 3. The hyphæ beneath and around the oogonium also became much branched, forming a complex weft. Fig. 4 shows a state much further advanced, the oogonium having become nodulose, and more nearly like an ordinary æcidium. These nodules, with exception of the basal row, which forms the peridium, are said to grow into the ordinary basidia of the æcidium. It does not appear that Mr. Massee was able to trace Fig. 3 directly into Fig. 4.

For the benefit of those who wish to make observations on other æcidia it should be stated that in the æcidium on *Ranunculus ficaria* this stage was found to be very fleeting. By the time the æcidia became visible all trace of it had disappeared. Sections through the leaves should be made when the spermogonia first appear, or while the future æcidium is indicated only by the faintest discoloration.—ERWIN F. SMITH.

Prillieux.—*Périthèces du Black-Rot.* Société Mycologique de France, tome IV, 2e fascicule, 1888, p. 60.

Tome IV of the reports of the Société Mycologique contains a paper by M. Ed. Prillieux upon the *Perithecia of the Black-rot* of grapes, in which there are several points worthy of special note. Prellieux believes that the pycnidia and spermogonia are changed into perithecia during the winter. After the asci had developed he found the mouth of the perithecia filled with a plug of gelatinous matter, probably composed of the remains of a layer of delicate parenchyma that bore the stylospores toward the end of summer. As the asci grow they push up this mass. The apex of the ascus is very slightly thicker than the rest of the walls, and probably becomes gelatinized when the end of a spore presses against it. In many cases, however, no opening is made, but the spores remain surrounded by a mucilaginous substance until the walls of the ascus disappear; undoubtedly the gelatinization of the apex has extended to the entire membrane. When the spores have become detached from this mass, a particle of transparent, gelatinous substance was seen attached to one end, probably for the purpose of fastening them to the leaves.

On the surface of berries which had passed the winter in the open air was found a dark-colored mycelium creeping over the cuticle and occasionally bearing spores on branches upright to the surface. Prillieux merely mentions their presence, and says he can not decide without further evidence as to whether they are part of the *Physalospora* or are some foreign fungus.—Effie A. Southworth.

MM. Pierre Viala et L. Ravaz. *Recherches expérimentales sur les maladies de la vigne.* Comptes Rendus, tome CVI, juin 18, 1888, *p.* 1711.

The *Comptes Rendus* contains a paper by Pierre Viala and L. Ravaz, read before the *Académie des Sciences* in June, 1888. It comprises a review of the main results of their experiments on the diseases of the vine.

The proof of the genetic relationship between the different forms of black rot and between the fungus on the leaf, stem, and fruit is noted. They also record the finding of the Perithecia in France, and state that they are either developed from pre-existing pycnidia or produced directly from mycelium filaments.

Besides the notes upon Black-rot, there are some on White-rot, Anthracnose, and Mildew. White-rot was produced on healthy leaves, stems, and berries by sowing the spores of *Coniothyrium*, thus showing the parasitism of the fungus, and that it was reproduced by stylospores.

The mycelium of Anthracnose was observed in the stems in a latent condition during the winter, and the formation of conidia from the same mycelium seen the following spring.

The identity of *Oidium Tuckeri* with the conidial form of *Uncinula spiralis* was established by comparison of specimens from France and America.—EFFIE A. SOUTHWORTH.

BRIOSI and CAVARA. *Funghi parassiti delle piante coltivate od utile, essiccati, delineati e descritti.* The parasitic fungi of cultivated and useful plants. Specimens, illustrations, and descriptions.

G. Briosi and F. Cavara, the managers of the Cryptogamic Laboratory at Pavia, Italy, anticipated the first fascicle of their collection and descriptions of the parasitic fungi of cultivated and useful plants by a circular letter to possible subscribers, in which they state that the reasons which led them to make the collection was to place in the hands of farmers, schools, and agricultural colleges a publication which will present the necessary elements for the easy determination of the parasites infecting plants of economic value.

This publication, they say, will consist of (1) specimens of plants attacked by parasitic fungi; (2) a drawing of the parasite and its organs of reproduction; (3) a short and accurate description of the fungus, accompanied by an indication of the remedies that have been sanctioned by experience.

They state that this is the first publication of the kind that has ever been issued, and while its preparation requires no small amount of labor, it is undertaken in the hope that it will prove of practical value.

The first fascicle has already been received by the Section, and proves to be all that was promised in the circular letter. The drawings are not elaborate, but clear, and convey a distinct idea of the fruit of the fungus, and these, combined with the descriptions and actual specimens, furnish sufficient data for the determination of any species contained in the collection.

The text is Italian, and this will hinder many who are directly interested in agriculture from obtaining much profit from the work; but the species comprised in the first fascicle are mainly those which are common in America as well as in Italy. It seems to us that a good translation would be of great practical value. There are twenty-five species in a fascicle, and each fascicle costs 7 lire in Italy and 8 ($1.57) in other countries. They are sent post paid, neatly put up.—EFFIE A. SOUTHWORTH.

WARD H. MARSHALL. *A Lily disease.* Annals of Botany, Vol. II., No. VII, pp. 319–382, with five double plates, 60 figures.

This paper is an important contribution to our knowledge of the biology of the form-genus commonly called *Botrytis.*

Professor Ward has demonstrated that a *Botrytis* of the *Polyactis* type, found for a number of years on the spotting and rotting stems, leaves, and flower buds of *Lilium candidum*, is a true parasite and the cause of the disease. He established the uniform connection of the fungus with

the spots; produced the disease in healthy lilies by sowing conidia in drops of water on their surface; and finally saw the penetration of the germ-tube and the development of the mycelium within the tissues.

This fungus is also capable of living as a saprophyte. Many interesting cultures were made, the most important discovery being that its mycelium secretes a ferment similar to that discovered by DeBary in *Sclerotinia sclerotiorum* and capable of dissolving cellulose. This ferment is frequently excreted from the hyphæ ends in the form of small yellowish drops. When fragments of lily tissues are thrown into this liquid the cellulose walls become swollen and soft and the middle lamella disappears. Pasteur's solution, in which the fungus had been grown, produced the same effect, as did also water in which a mass of the mycelium had been bruised. Portions of the same solutions after two minutes' boiling produced no effect whatever. Evidently the boiling destroyed or dissipated the active substance. By addition of alcohol Professor Ward succeeded in obtaining a white flocculent precipitate which, when redissolved in water, produced the same effect as the excretion itself. "The middle lamellæ of all the parenchyma cells were destroyed and the cells isolated as if they had been boiled, while the cellulose walls swelled up and became distinctly lamellated and folded." He believes this white precipitate consists chiefly of a ferment related to a zymase, but he has not been able to isolate it perfectly. To its presence the hyphæ ends owe their remarkable power of boring through cellulose walls, which he observed repeatedly. The wall in front of the advancing hypha becomes swollen, softened, and finally dissolved. The rapidity with which this takes place is sometimes remarkable. In one instance it was completed in 10 minutes, in another, in 30 minutes. He thinks the irritation of contact induces a more copious production of this ferment, the extrusion of which he observed in many instances where the hyphæ ends touched the sides of flasks or the surface of slides and cover-glasses.

Another curious fact, often noticed, however, by other observers, was the anastomosing or conjugating of hyphæ. This was astonishingly frequent in cultures after the first two days, the mycelium becoming a perfect net-work by means of cross-connections. In some instances Professor Ward observed a hypha end move through an arc of more than 90 degrees for the purpose of uniting with another, and, as he remarks, "it is difficult to avoid the impression that the two or more bodies concerned are attracting one another in some way." He thinks the softening and disappearance of the hyphæ walls to form such unions is due to the presence of the previously mentioned soluble ferment. He also inclines to believe that the softening of walls, due to the localization of this ferment in given portions of the mycelium, is what determines branching. This, however, is theoretical. Mere contact of hyphæ does not always lead to their union, and it is suggested that this anastomosing may be the result of an effort "to equilibrate certain

differences which have unavoidably made themselves apparent in the metabolic processes."

Professor Ward was not able to establish the connection of this fungus with any other form, but believes it to be the conidial state of some *Peziza*, of which there would seem to be little doubt.—ERWIN F. SMITH.

EXPLANATION OF PLATES.

PLATE I.

Figs. 1-11. *Tilletia buchloëana*, Kell. & Sw. on *Buchloe dactyloides*.

1-4. Affected ovaries of various sizes, x 6.

5. A spore showing sub-reticulate markings, and pedicel of attachment (?), x 500.

6. Spore showing unusually prominent spines and two layers of the hyaline envelope, x 500.

7. An optical section of an immature spore showing the two layers of the hyaline coat; the inner extending from the wall to the tips of the spines; the outer spinose and inner lighter thinner wall; the granular layer, and the collapsed center, x 500.

8-10. Optical sections of mature spores showing but one hyaline layer; Fig. 9 shows the rudiment of the pedicel of attachment (?), x 500.

11. A male spikelet consisting of three flowers all bearing ovaries which are filled with the mass of spores.

Figs. 12-25, *Ustilago Andropogonis*, Kell. and Sw. on *Andropogon provincialis* (Figs. 12-18 on *A. provincialis*) and *A. Hallii*, Hack.

12-14. Affected ovaries of various sizes, x 3.

15. A portion of the rachis showing a normal sessile, and a pedicelled flower, also an extra short pedicelled one which (like the sessile one) bears an infested ovary, x 3.

16. A portion of the rachis bearing normal flowers, the sessile pistillate and affected, the pedicelled one staminate and free from the disease.

17. Two spores of *Ustilago andropogonis* from *A. provincialis* seen in optical section showing spines, thickness of cell-wall, and granular contents, x 500.

18. Three spores of same showing common sizes and shapes, x 500.

(Figs. 19-25, *Andropogon Hallii*.)

19-22. Affected ovaries of various sizes, x 3.

23. A portion of the rachis bearing sessile (fertile) and pedicelled (normally sterile) flowers, both producing smutted ovaries.

24. Three spores of *Ustilago andropogonis* from *A. Hallii*, showing common sizes and shapes, x 500.

25. Two spores seen in optical section showing thickness of cell-wall and granular contents, x 500. As will be seen by comparison with Fig. 17 the spores from *A. Hallii* had a slightly thicker wall than those from *A. provincialis*.

Figs. 26-40. *Ustilago boutelouæ*, Kell. & Sw. on *Bouteloua oligostachya*.

26-28. Affected ovaries of various sizes, x 6.

29. An affected spikelet distended and the palet split by the enlarged smutted ovary, x 6.

30. Six spores showing common sizes and shapes, x 500.

31. Three spores seen in optical section showing spines, thickness of wall and slightly granular and guttate ? contents, x 500.

(Figs. 32–40 showing germination of spores of *Ustilago boutelouæ* in distilled water on slide in damp chamber 24 hours at 37° C.; collected December 20, 1888, germinated February 20, 1889.)

32. Spore showing cleft in the wall and young promycelium, x 500.
33. Spore bearing a branched promycelium which has split the cell-wall and about to produce a sporidium on the side (?), x 500.
34. Spore showing two promycelia, the one scarcely developed, x 500.
35. Spore seen in optical section showing a slender promycelium apparently connected with the contained gutta, x 500.
36. A spore with a more mature promycelium which is either branched and bearing a sporidium at the end of the branch, or a primary sporidium is producing a secondary one, x 500.
37. A free sporidium budding, x 500.
38. A promycelium broken off from the spore, bearing two sporidia from below the septa, x 500.
39. A free promycelium bearing a single sporidium, x 500.
40. A slender free promycelium producing a single sporidium, x 500.

Plate II.

Fig.

1. Cross-section of cells of normal ground tissue; *a*, intercellular spaces.
2. Longitudinal section of cells of normal ground tissue.
3. A section of a portion of the normal epidermis with the underlying parts; *a*, epidermal cells; *b*, sub-epidermal layers; *c*, cells of the ground tissue.

Plate III.

4. Cross-section of a normal fibro-vascular bundle; *a*, intercellular canal; *b*, annular vessel; *c*, pitted ducts; *d*, phloëm; *e*, elements of the bundle sheath.
5. Longitudinal section of a normal bundle; *a*, cells of ground tissue; *b*, elements of bundle sheath; *c*, cambiform cells; *d*, sieve tubes; *e*, tracheid; *f*, portions of an annular vessel; *g*, intercellular passage; *h*, wood parenchyma.

Plate IV.

6. Longitudinal section of normal epidermis; *a*, large; *b*, small cells of epidermis; *c*, sub-epidermal cells.
7. Surface view of normal epidermis; *a*, large; *d*, small cells; *b*, guard cells; and *c*, accessory cells of the stomata.
8. Diagram of a section of a stem with the abnormal growth; *a*, *b*, stem; *c*, abnormal growth; *e*, bundles; *d*, region of active growth. The light shading represents ground tissue cells, the dark shading masses of spores, and the lines in *c* the bundles sent out to the abnormal growth.
9. Section similar to that represented in Fig. 3, except that it is slightly distorted; *a*, epidermal and sub-epidermal layers; *b*, ground tissue cells; *c*, portion of a bundle.
10. Surface view of epidermis of abnormal tissue; *a*, epidermal cell; *b*, nucleus.

11, 12. Surface view of abnormal tissue showing distortion of stomata; *a* guard, cells; *b*, accessory cells; *c*, epidermal cell.

PLATE V.

13, 14. Surface view of abnormal tissue showing distortion of stomata; *a*, guard cells; *b*, accessory cells; *c*, epidermal cell.

15. Cross-section of cells of abnormal ground tissue in region of active growth, showing nucleii.

16. Cross-section of the same a little nearer the periphery nucleii not so conspicuous, and are not represented.

17. Cross-section of the same still nearer the periphery.

PLATE VI.

18. Cross-section of the same near the periphery with *a*, the epidermal cells.

19. Cross-section of a distorted bundle; *a*, intercellular canal; *b*, annular vessel; *c*, pitted duct; *e*, element of bundle sheath; *f*, wood parenchyma.

PLATE VII.

20. A section in abnormal tissue showing *a*, longitudinal section of a bundle, also a mass of mycelium filaments in early fruiting stage.

21. Longitudinal section of a more typical abnormal bundle; *a*, branch of the bundle.

22. Cross-section of the abnormal bundle.

23. Mycelium filament.

24. Mycelium filaments running through cells of the ground tissue.

25. Early stage of spore formation.

26. Later stage of spore formation.

27. Mature spore.

— = .01^{mm}, scale to which the figures are drawn.

PLATE VIII.

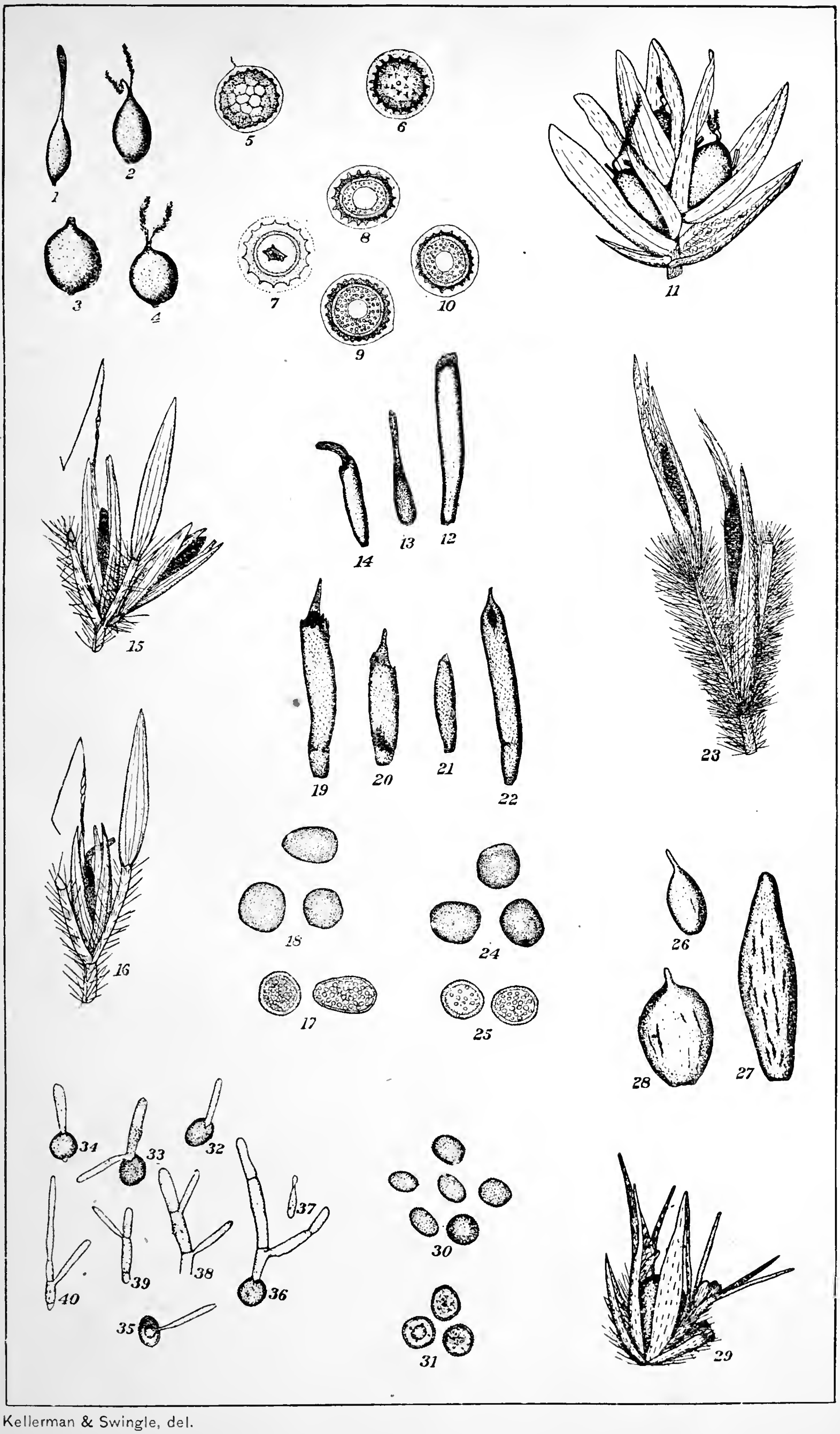
Fig. 1. Upper surface of pileus of *Mucronoporus tomentosus*, Fr.

2. Lower surface of same.

3. Section of pores showing the projecting points or spines.

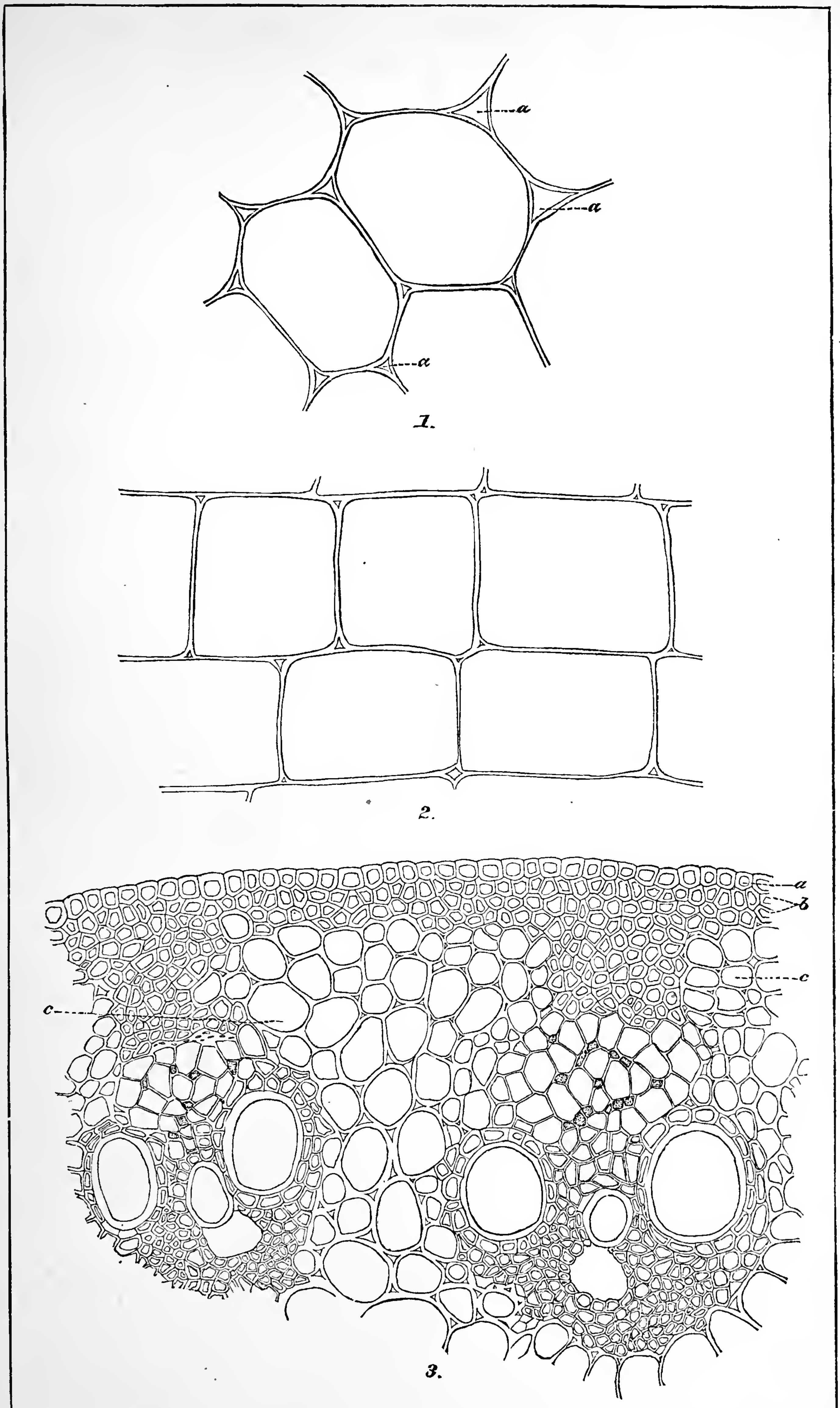
4. One of these spines more highly magnified.

5. Spine with a bifid tip.



Kellerman & Swingle, del.

KELLERMAN AND SWINGLE ON NEW SPECIES OF KANSAS FUNGI.



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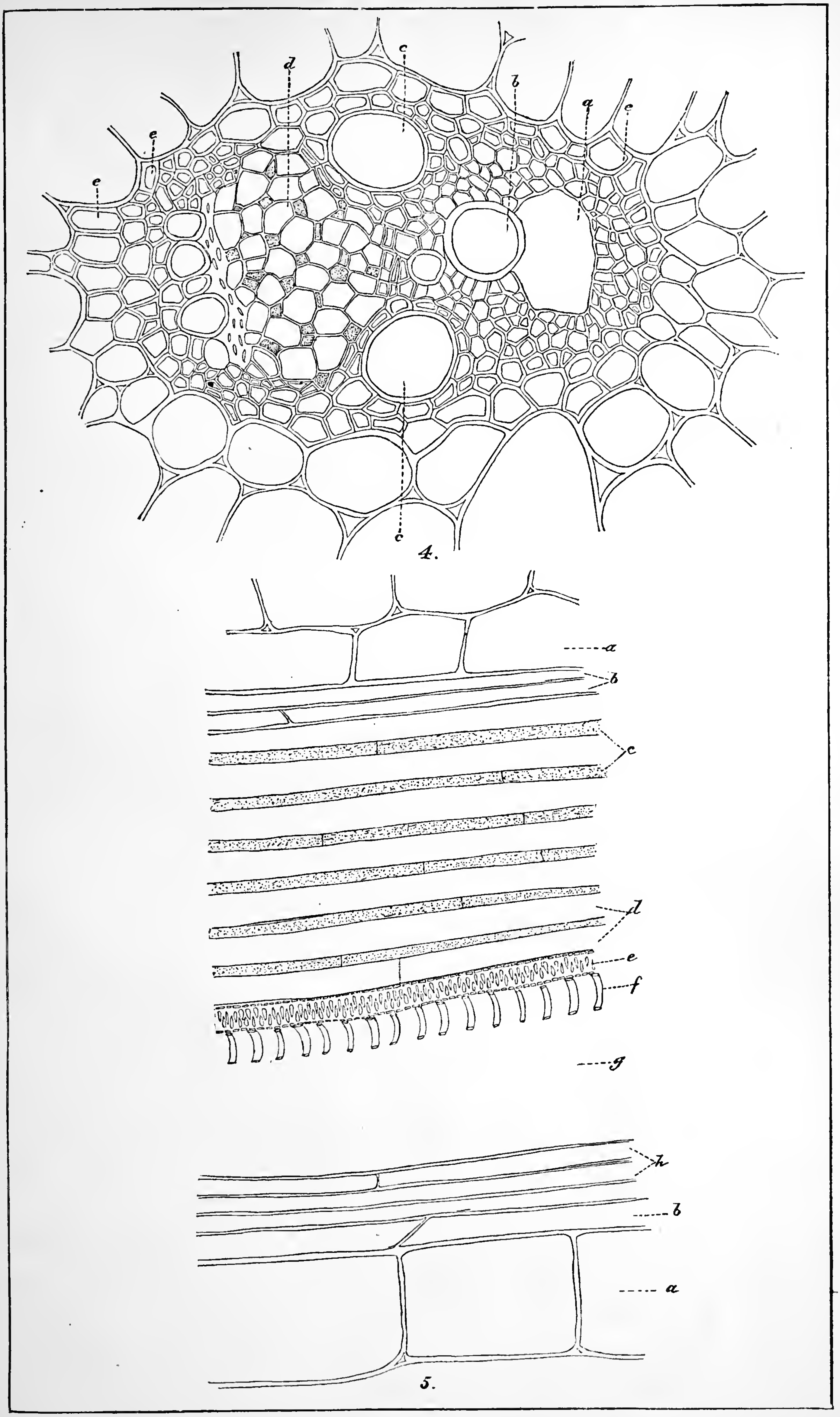
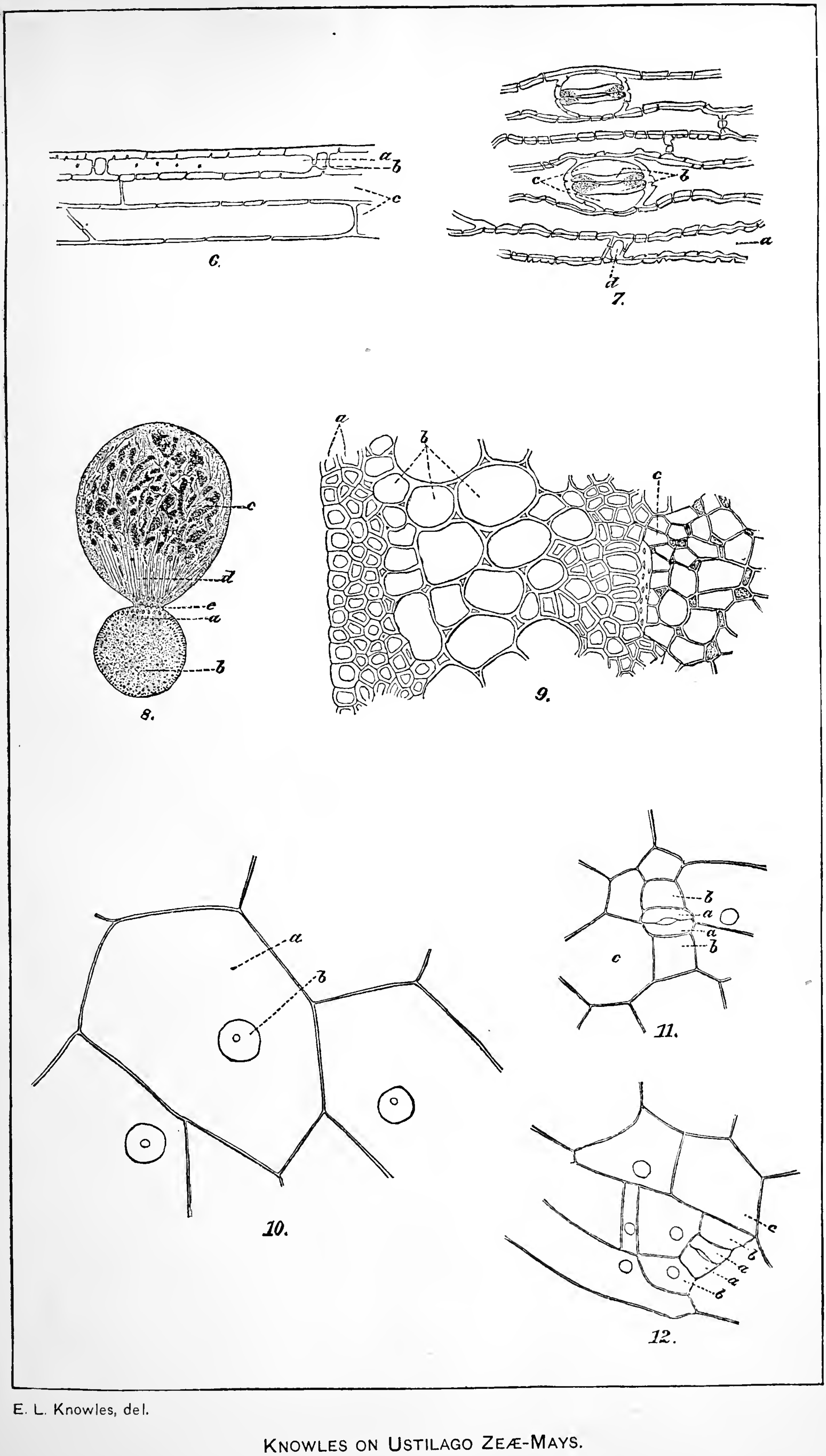


E. L. Knowles. del.

KNOWLES ON USTILAGO ZEÆ-MAYS.

PLATE IV.



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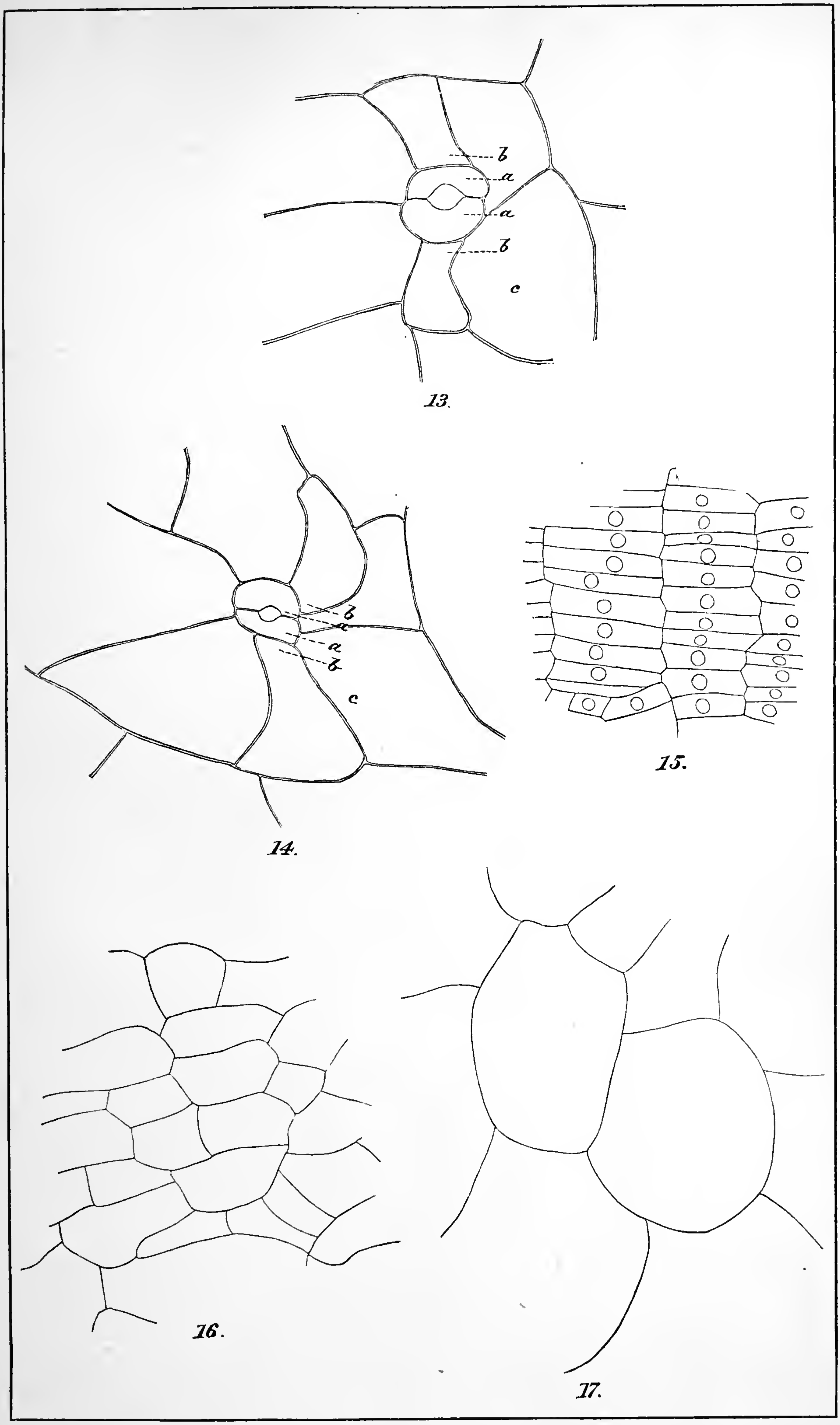

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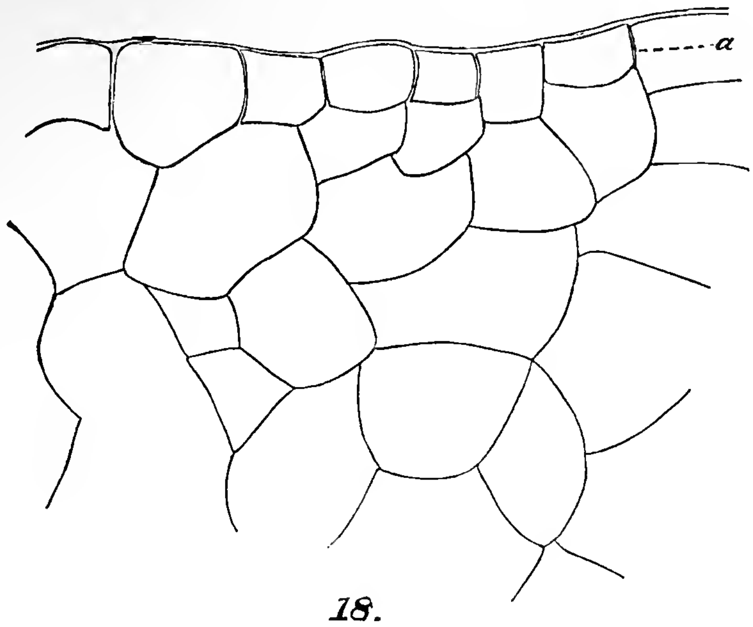

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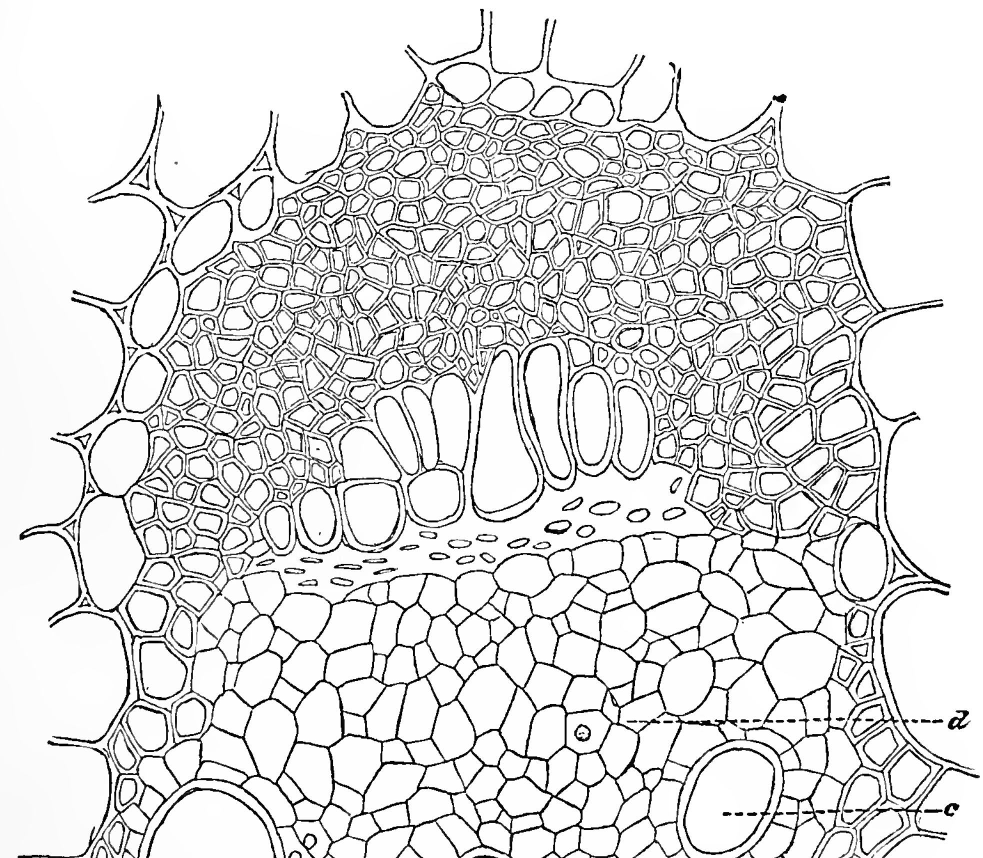

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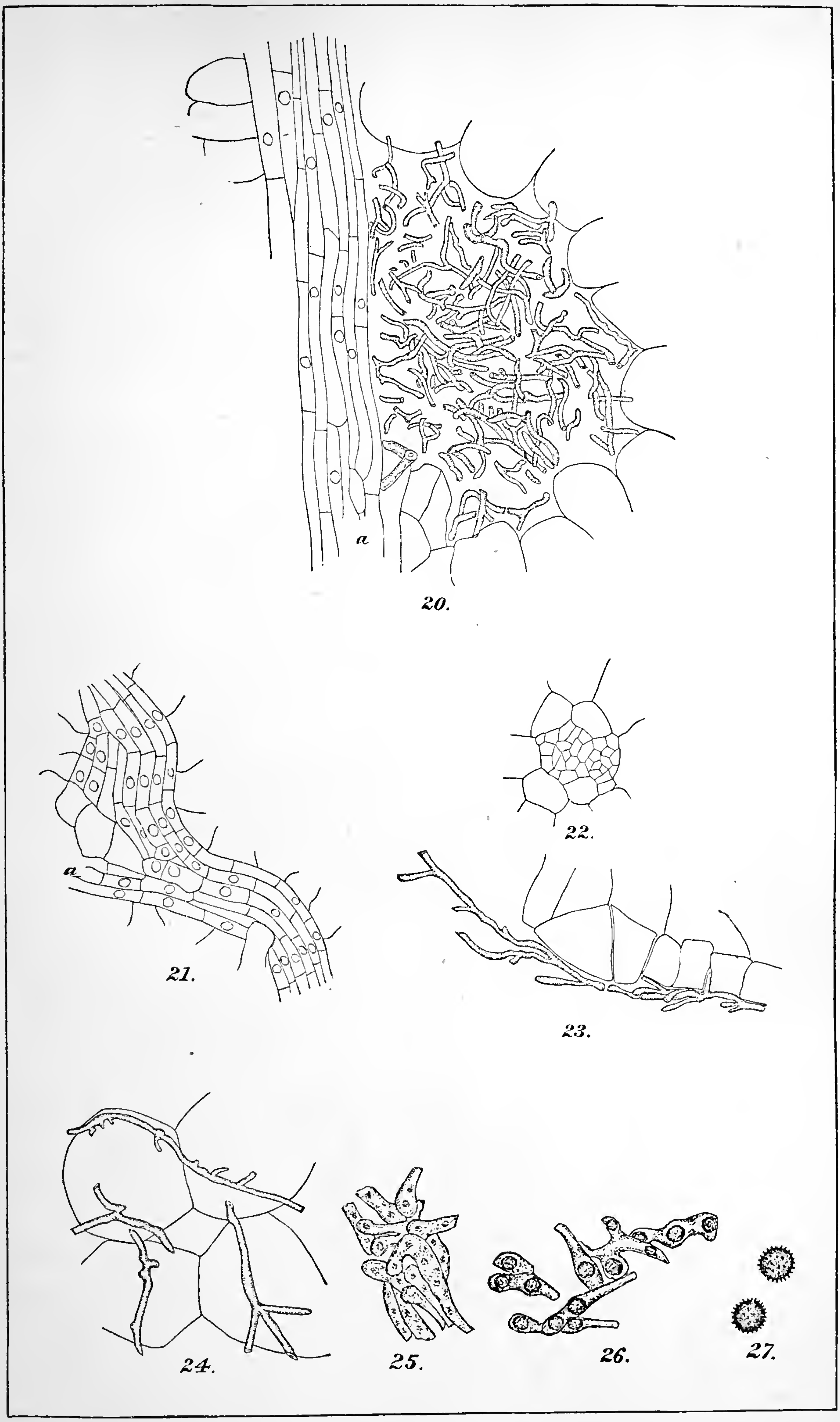

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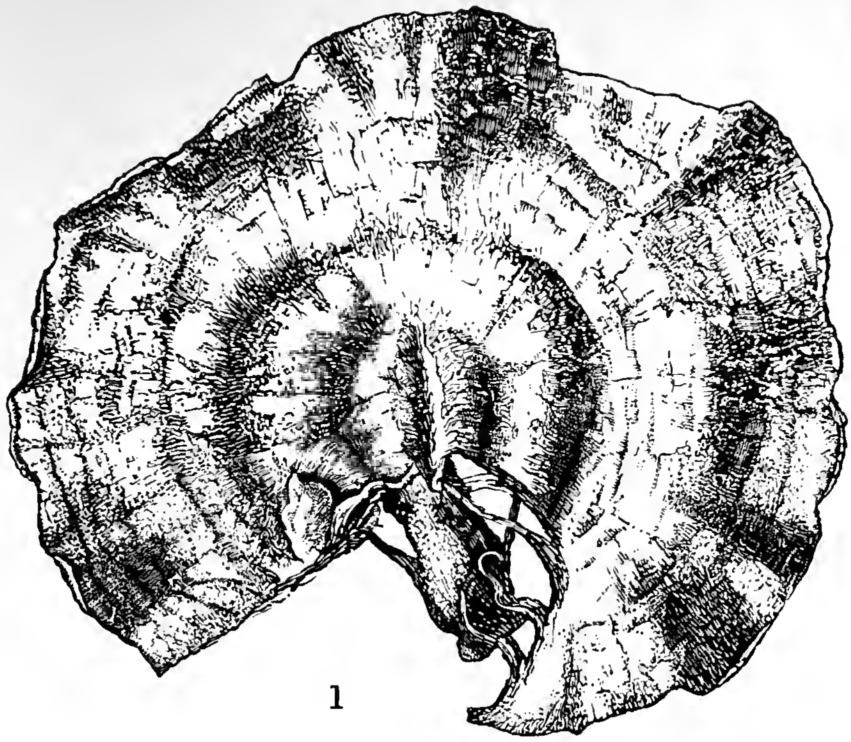

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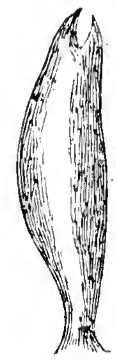

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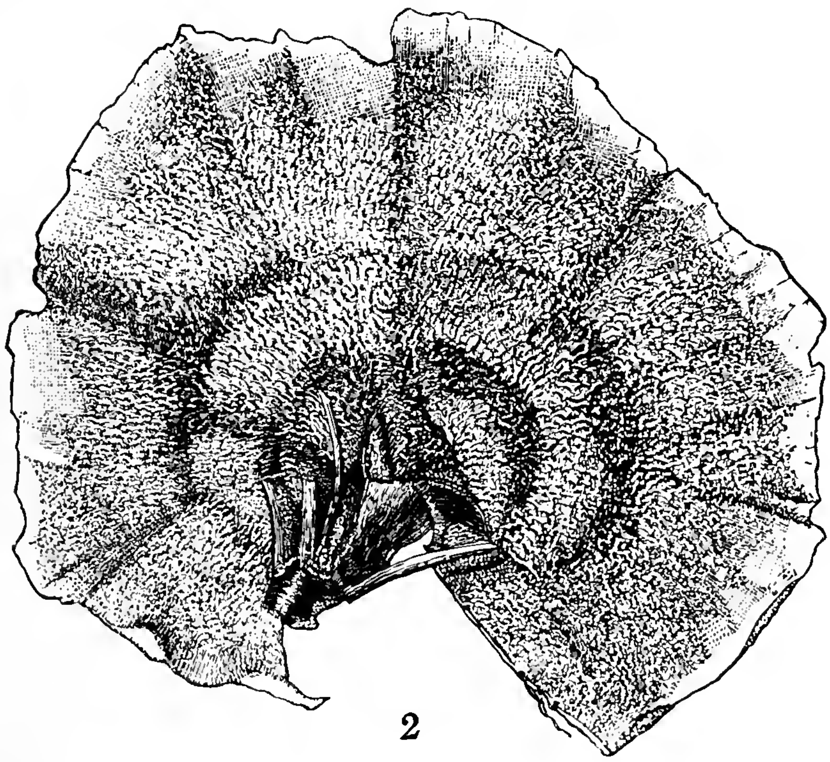

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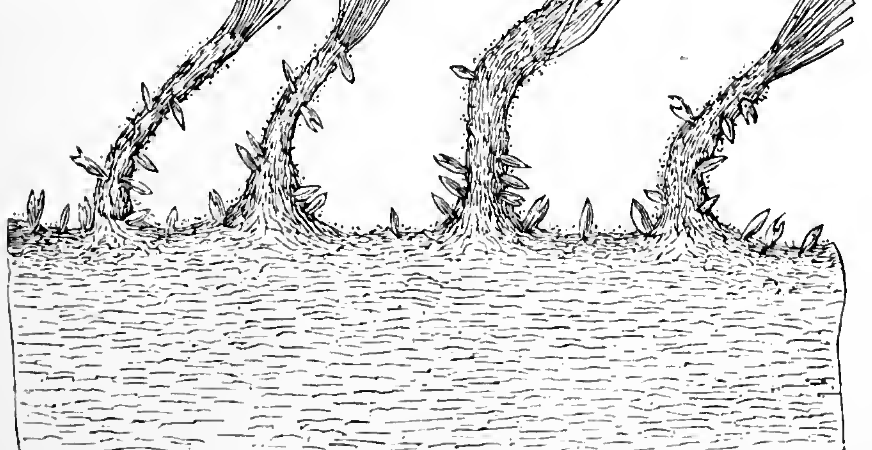

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JL Sc. Roberta Cowing del.

ELLIS ON MUCRONOPORUS TOMENTOSUS, FR.

U. S. DEPARTMENT OF AGRICULTURE.

SECTION OF VEGETABLE PATHOLOGY.

QUARTERLY BULLETIN. JUNE, 1889.

Vol. 5. No. II.

THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

PREPARED, UNDER THE DIRECTION OF THE SECRETARY OF AGRICULTURE,

BY

B. T. GALLOWAY,

CHIEF OF THE SECTION.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1889.

CONTENTS.

GLŒOSPORIUM NERVISEQUUM, (FCKL.) SACC.

By E. A. Southworth.

The sycamore blight caused by the fungus *Glœosporium nervisequum* has been very abundant in various parts of the country for the past few years. In some cases trees have been killed outright by the disease and in many the growth of the early part of the year has been completely destroyed. The sycamore is extensively planted as a shade tree, and its wood is used almost exclusively for making tobacco boxes. It is stated that one mill on the Embarras River in southern Illinois has within a few months received orders for 11,000,000 feet of sycamore lumber, and that other mills throughout that region are busy sawing up the great trees. If this demand continues it will soon be necessary to take some steps to keep up the sycamore supply, but when the trees are attacked each year with a destructive disease their existence is seriously threatened. Effects of the disease are so prominent that during and soon after its active season trees which have been affected can be readily distinguished for a long distance. Fortunately for the trees, the disease continues active only a small portion of the year, and during the greater part of the summer they have a chance to partially recover from the disastrous effects of the attack. But even under these favorable circumstances, it is evident that the growth is greatly retarded. Last spring the disease attacked full-grown and young leaves, mostly near the ends of branches. Sometimes the young unlignified stem was attacked at some distance from the end, and then, of course, all the leaves beyond this point would wilt, although no fungus could be discovered on them. The petioles were very commonly attacked. The trees thus diseased had a scorched and wilted appearance.

This spring the attack in Washington was quite different. Comparatively few full-grown leaves were affected, but the external leaves of the unfolding buds showed the disease as soon as they were half out, and many entire buds died before they were fairly open. In other cases the

inner leaves grew out without showing any traces of the disease. In fact, nearly every stage was present between buds which were quite dead before winter was over and buds which opened in a healthy and natural manner. The general impression gained from an examination of the trees when the first leaves were about half grown was that the buds must have been infected in some cases by spores which had lodged on them before they started to grow, and that in others the mycelium must have entered them from the branch. Those buds of which only the outer leaves were affected belong to the former class, and those which shriveled up because the axis that was still in a meristematic condition was attacked, belong to the latter. This is, however, merely a surmise, for it is quite possible that this case was simply caused by spores which had been washed by the rains further into the folds of the buds, and were consequently in a position where their germ tubes could penetrate the axis itself, and the mycelium produced from them enter the woody portions through the more delicate tissues of the bud. One thing, however, seems evident, this attack, which showed itself so early in the spring, can not be due to the same infection which now produces the characteristic spots of *Glœosporium nervisequum* along the veins of some of the full-grown leaves. The disease is very scarce in Washington at present, but in other parts of the country the same state of affairs exists that existed here last spring. The leaves are for the great part diseased, some showing large brown patches, others withered from the effects of a diseased petiole or growing branch, and the ground is covered under the trees by leaves which have fallen from the effects of the fungus at the base of the petiole.

The existence of large numbers of dead twigs on the trees at the time the blight is most active, and the appearance of other leaf fungi after the *Glœosporium* has ceased its attacks, raise the question at once whether some of these do not have some connection with the leaf blight. I have studied the question for some time, but all my experiments have produced merely negative results.

The following paper by Franz von Tavel contains descriptions of some of the most prevalent and important of these forms, together with detailed accounts of his experiments made with a view of determining their life history. It probably represents our best knowledge of the subject. The paper was published in German in the *Botanische Zeitung* for 1886; only a portion is printed in this number of the Journal, but the remainder will appear in succeeding numbers.

CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES. *

(Plate IX.)

By Franz von Tavel.

The *Ascomycetes* have already been the object of many researches resulting in a series of most interesting facts which in turn always suggest new questions. To solve these requires investigations in two directions. First, the development and significance of the separate organs, especially of the pycnidia and perithecia, should be better established. Athough much has been done in this respect, still the manifold forms of the *Ascomycetes* leave many new facts to be expected, and the results already obtained are too scattered to admit of any generalization. Second, the life history of the pleomorphic forms demands thorough investigation. We know a large number of pycnidia and other gonidia forms, and conclude that each represents a stage in the development of an Ascomycete, but this has been definitely proved in only a very few cases.

What follows contains a series of observations in the two directions already indicated, having as their object some gonidia forms and *Pyrenomycetes* of doubtful relationship, but not giving a complete chain of development. We will first attempt to solve the question as to what cycle of development the common *Glœosporium nervisequum*, (Fckl.) Sacc., a dangerous enemy to the sycamore trees, belongs. For reasons given below the question must remain almost entirely unanswered, but other forms of fungi were found in the course of these investigations. A pycnidium, *Discula platani*, (Pk.) Sacc., is suspected of belonging to the same cycle of development as the *Glœosporium* and was consequently very closely investigated. Together with this *Discula* appeared a *Fenestella* whose life history could only be established to a certain degree of completion. A *Cucurbitaria* found growing with the two other forms was studied in relation to the development of its pycnidium, more exhaustive observations being prevented by the lack of material. In what follows I have brought together my observations on these four forms.

It should be mentioned that the three last-named fungi live on dry branches. It is well known that these, like lichens that grow upon bark, can not be cultivated except with difficulty. Hitherto they have only attained a limited age in culture fluids. It is extremely difficult to cultivate them on dry twigs because it is impossible to sterilize other twigs without destroying the objects of our observations, and foreign fungi, which make observations difficult and results uncertain, invade the cultures and in many cases so get the upper hand as to destroy all other fungi. *Tricothecium roseum*, Lk., is an especially dangerous fungus.

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* *Bot. Zeitung*, 1886, p. 824.

It is with difficulty that a twig can be kept in a moist chamber without this species making its appearance.

I. Glœosporium Nervisequum, (Fckl.) Sacc.

The *Platanus* (sycamore) frequently exhibits an epidemic disease that is especially injurious to the young trees. The first manifestation of the malady is the wilting of the young leaves. Soon after they unfold, about the middle of May, brown spots make their appearance on any portion, and extend along a vein, toward the base, over the leaf, and even on the pedicel, until the leaf finally falls off. Upon these dry places are small black dots just visible to the naked eye, and representing the gonidial form of a fungus probably belonging to the *Pyrenomycetes*. It has been seen in most cases on *Platanus occidentalis*.* Léveillé, Fuckel, and Saccardo state that it also occurs on *Platanus orientalis*, but I have not been able to prove these statements. In addition to this, Fuckel refers to a form growing on the oak,† which he has distributed in his F. Rhen. No. 428.

This fungus has been known for a long time. It was first described by Léveillé as *Hymenula platani* in 1848, but it is surprising that neither he, Fuckel, or Saccardo mention its destructiveness. In his *Symbolæ*, p. 369, Fuckel cites it as *Fusarium nervisequum* and gives an illustration of one of the spores. In the F. Rhen. No. 427 it is called *Labrella ? nervisequum*, Fckl. Saccardo placed the fungus in the broader genus *Glœosporium* and adopted Fuckel's specific name, since a *Glœosporium platani*, (Mont.) already existed. It is therefore known as *Glœosporium nervisequum*, (Fckl.) Sacc.

If the infected areas are placed under a low magnifying power they show brown or black pustules which are elongated in form and most generally located in the angle formed by the vein and the leaf surface, but are also found on both these parts. Generally they occur upon the upper side of the leaf; much more rarely upon the lower.

The structure of the fungus may be seen in a cross-section of one of these pustules (Fig. 1). The fungus destroys the walls between the epidermal cells, and the outer wall with the cuticle arches up until it bursts when the spores are ripe. The base of the pustule is lined with a pseudoparenchymatic tissue composed of small cells which may be called a stroma. From this arise numerous hyphæ which penetrate the leaf, passing between the cells and completely destroying the leaf tissues. From the upper side of the stroma numerous hyphæ or basidia grow out into the cavity of the pustule. These swell up and become club-shaped and cut off spores from the end. They are of unequal lengths, and the club-shaped swellings begin with the growth of the basidia. The spores are detached in great numbers; when the epidermis ruptures they exude in the form of a worm-like, whitish-yellow mass. They are very irregular in shape, being mostly elliptical or pear-shaped, and

* It has been found in California on *P. orientalis* by Harkness.

† Specimens on oak have been sent to the Department from Indiana.

are always one-celled and colorless (Fig. 2). The smooth, delicate spore membrane is surrounded by a gelatinous envelope. The spores measure 9–14 by 5–6μ, agreeing with the measurements made by Fuckel and Saccardo. They germinate in a few hours in water or a nutrient solution, and develop a germ tube which soon branches and forms septa; the cells lying next to the spore swell more or less.

A mycelium is formed in a few days by means of the rapid growth of the germ tube and repeated branching. The hyphæ are of unequal diameter, and are made up of short, often somewhat swollen cells. When the mycelium grows in a nutrient solution gonidia are formed after some time. The short cells of the thicker hyphæ develop outgrowths which are cut off, the mother cell and gonidia both being filled with dense protoplasm; or on the other hand, the hyphæ cells may first develop basidia, which cut off spores from the end. Both forms of development may occur simultaneously on the same hyphæ. The gonidia themselves are alike, and agree in form and size with those produced on the leaf excepting that they are a little more regular. From this, and from the fact that the gonidia are produced more abundantly where the hyphæ are more closely interwoven, we may conclude that the gonidia produced in culture on the slide are homologous with those produced on the leaf, and that the hymenium not attaining to the same degree of development is due to the changed mode of growth. This question can not be definitely decided, for the fungus on the slide did not develop farther, and attempts at infection were without result.

Leaves of *Platanus* were infected with the *Glœosporium* in the most varied ways—upon the upper and lower surface, upon young and old leaves, on detached branches and uninjured trees; the cultures were kept moist and dry, and the germinating power of the spores was controlled by cultures on slides, but not a single infection gave a positive result. It can therefore at present only be said in regard to the life history of the *Glœosporium nervisequum* that the gonidia will produce a similar gonidial stage on the slide.

Is it possible, then, to draw the conclusion that this closes the life history of the fungus; that is, that it has lost the perithecia and pycnidia stages, as has been supposed true of *Botrytis bassii*, *Isaria strigosa*, and *Oidium lactis*, although we are by no means forced to such a conclusion? If this is true, we must assume that the spores fall to the ground, survive the winter among the fallen leaves, and in the spring are carried to the leaves by means of the wind or some other agent. This inference is supported by the fact that the disease begins nearest the ground. The leaves on the lower branches wither first; the upper ones gradually follow. On the other hand, it is not conceivable that these delicate, thin-walled spores could survive the winter lying upon the damp earth, especially since they germinate very readily on the slide upon the addition of moisture without requiring a resting period. And if these were the agents in the penetration of the leaves it is not likely that all

our experiments would meet with negative results. The evidence rather points towards discarding the idea that *Glœosoporium nervisequum* has no other stages in its life history.

It has not yet been possible to find out these other stages; the cultures could not be carried far enough, and forms that might belong to the *Glœosporium* were found in the open air on fallen leaves and dry branches, but we were not able to establish the connection. One form which we especially suspected of organic relationship, on account of its morphological evidence, is described in detail in what follows.

II. Discula platani, (Pk.) Sacc.

Upon *Platanus* trees attacked by *Glœosporium* there are many dry branches of the previous year's growth, which died after all the leaves had fallen, and before the close of the vegetative period. Upon these are usually a large number of small pustules which finally split open. At first they look very much like lenticels, and can scarcely be distinguished from them by the naked eye; but when one of these twigs is moistened small yellowish columns emerge from all the openings; these columns are composed of spores, and show the presence of a fungus.

The structure of the fungus may easily be studied in a cross-section of the branch. The young pustules are filled with a pseudo-parenchymatic tissue which rests upon the green part of the bark and penetrates it slightly. Above (by above is meant the side turned away from the twig) the fungus pushes up the bark until it finally bursts (Fig. 3). The tissue is then in the form of a cone. The basal cells are nearly isodiametric and polygonal, but the upper ones are elongated and lie more or less parallel. The point of the cone does not project beyond the bark, and the hyphæ are more apt to swell up when they reach the surface. The entire cone shows a strong upward growth which has its origin in the lower cell layer. This layer has here the function of meristem and pushes up other portions of the cone by the elongation of its cells.

In more advanced stages pseudo-parenchyma is also developed in the uppermost layer of bark parenchyma whose cells have been completely destroyed. A cavity quickly arises in the cone by the cessation of growth in the central part (Fig. 4). Hyphæ very quickly grow out into the cavity from all sides and clothe it with a hymenium which produces spores by successive abscision. The cavity enlarges especially towards the surface; the remains of the parenchyma together with the cone above them are pushed up considerably, enlarging the slit in the bark. The hyphæ forming the cone generally become completely obliterated; very rarely only a pore is formed therein; by these processes the hymenium is exposed. The outer portions become-dark colored and the entire pustule is more or less bowl-shaped (Fig. 5).

The basidia are unbranched, slender, and cylindrical. The spores are

one-celled, colorless, oval to pyriform, surrounded by a thin gelatinous envelope, and measure 10–14 by 5–7μ. They have a striking resemblance to the spores of *Glœosporium nervisequum*.

It is evident from the form of the open conceptacle that the fungus belongs to the *Excipulaceæ*. It agrees perfectly with the description of *Discula platani* Peck (Sacc. Syll., Vol. III, p. 694).

On account of its mode of development *Discula platani* must be regarded as a pycnidium, but it differs in several points from what we usually call pycnidia. The body of tissue remains intact longer than is usual and it is also different in being differentiated into two kinds of tissue. The upper part of the pycnidium with the elongated cells corresponds with similar formations on the walls of other pycnidia, as will be shown below in case of *Fenestella* (Fig. 11). The pore always makes its appearance at the spot where the elongated cells were developed. In *Discula* this attains such very considerable dimensions that the entire pycnidium is destroyed down to the bowl-shaped basal portion, and besides this the phenomena of growth are peculiar to *Discula*. *Discula* does not, however, stand alone in this. Banke (Beitr. z. Kenntn. d. Pycniden in Nova Acta Acad., Leopold., XXXVIII, p. 481) demonstrated an apical growth of the pycnidia of *Pleospora polytricha*.

Nothing is known concerning the farther development of the *Discula*. In fact it was only in rare cases that we succeeded in following the development until the hymenium was exposed. A few days after the branches were brought into the house *Tricothecium roseum* attacked the pycnidia where they had broken through the bark and completely destroyed them.

When sowed in water or nutritive fluid the spores of *Discula* germinate in about twenty-four hours. They generally give rise to two, more rarely one or three, germ tubes, which swell up, forming spherical bodies. The growth is at first similar to the budding that occurs in yeast, showing repeated branching and budding, surrounding the spore in a dense tangle. One of the branches finally exhibits a decided apical growth and develops into a hypha branching monopodially. No septa are present for some time, but they appear later in considerable numbers. A vigorous mycelium develops rapidly but it never attains the production of spores. Frequently a few cells either at the ends or along the course of the hyphæ swell up and assume a spherical shape, and sometimes this happens for two adjacent cells; in the latter case the sphere is divided by a septum. The contents is watery and the protoplasm simply forms a lining within the wall.

Leaves and branches of *Platanus* were inoculated with *Discula* in the same manner as with the *Glœosporium* but with no results. The leaves remained fresh for a long time and then began to wither and turn brown without showing any signs of a fungus.

Discula platani is found on dry branches of *Platanus* during the entire year, and it was once discovered upon the petiole of a large decaying

leaf, in December. Owing to the fact that it is always found associated with *Glœosporium nerrisequum* and in its immediate vicinity, it is suspected that the two are stages in the development of the same fungus, the more so because the spores are so very similar. It is conceivable that the mycelium passes from the petioles into the branches and there produces the pycnidia of *Discula* whose spores develop into *Glœosporium* upon the leaves.* But such a connection could not be established either by natural or artificial methods, and the question still remains an open one.

(*To be continued.*)

NORTH AMERICAN AGARICS.

(Genus *Russula* (*russulus*, reddish). Fr. Hym. Eur., p. 439.)

By Robert K. Macadam.

Part I.

Pileus fleshy, convex then expanded, and at length depressed; stem *stout*, polished, *not corticate*, generally *spongy* within, confluent with the hymenophore; gills *nearly equal*, *milkless*, *rigid*, *brittle*, with an acute edge, sometimes dropping *water;* trama vesiculose; veil entirely *obsolete;* spores white or very pale yellow, generally echinulate.

Habitat.—On the ground, generally in woods or the vicinity of trees in summer and autumn.

This genus is interesting on account of the beauty and brilliant coloring of many of its species, and especially so to amateurs, as it is one of the few divisions of *Agaricini* which can be readily distinguished. Members of it may be recognized by the stout spongy stem, dry texture, and extreme brittleness; they are generally found in grassy woods and are of nearly all colors, frequently with the cap a brilliant red, pure white, or white blotched or shaded with red. *Russula* is allied to *Lactarius*, but is distinctly separated by the absence of *milk* in the gills; those of some *Russulæ* distill drops of water, especially in rainy weather. The internal structure is also related, as shown by the presence, in the acrid species, of the milk-secreting vessels of *Lactarius*, but in an undeveloped form.

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* At the bases of the infected shoots this spring there was almost invariably a dead area on the lignified branch, and mycelium was invariably present in the tissues; this mycelium penetrated into the vessels of the wood and could not be morphologically distinguished from that in leaves infested with *G. nervisequum*. Many buds had died either in late autumn or during winter and there were similar but larger dead areas around them, and in these *Discula platani* often made its appearance. Indeed, it is almost impossible to avoid the conclusion that the mycelium of *Glœosporium nervisequum* extends into the woody parts of the branches, where the fruit of the fungus assumes a different form. The formation of the mass of pseudo-parenchyma may possibly be explained on the ground that it is necessary in order to rupture the epidermis and cork layer of the bark; and when this is accomplished it disappears.—E. A. S.

The genus contains some of the best edible mushrooms and others which are extremely poisonous, and, on account of the extreme variability of color, they often resemble each other so closely that the amateur must depend entirely upon taste in selecting the esculent ones.

Taste a piece of the stem of *each* plant as gathered and reject all not having a mild and pleasing flavor, as all the known noxious species are acrid or unpleasant. Be sure that your plant is a *Russula*, as this rule is *not* universal and *must not* be applied to mushrooms in general. The application of this method will enable the novice to enjoy some of the best viands in this class.

"I. COMPACTÆ (*compingo*, to put together; compact). Pileus fleshy throughout, hence the margin is at first bent inwards and always without striæ, without a distinct viscous pellicle (in consequence of which the color is not variable, but only changes with age and the state of the atmosphere). Flesh compact, firm. Stem solid, fleshy. Gills unequal.

"II. FURCATÆ (*furca*, a fork. With *forked* gills). Pileus compact, firm, covered with a thin, closely adnate pellicle, which at length disappears, margin abruptly thin, at first inflexed, then spreading, acute, even. Stem at first compact, at length spongy-soft within. Gills *somewhat forked*, with a few shorter ones intermixed, commonly attenuated at both ends, thin and normally narrow.

"III. RIGIDÆ (*rigidus*, rigid). Pileus without a viscid pellicle, *absolutely dry*, *rigid*, *the cuticle commonly breaking up into flocci or granules.* Flesh thick, compact, firm, vanishing away short of the margin, which is straight (never involute), soon spreading, and always *without striæ.* Stem solid, at first hard, then softer and spongy. Gills, a few dimidiate, others divided, rigid, *dilated in front and running out with a very broad rounded apex*, whence the margin of the pileus becomes obtuse and is not inflexed. *Exceedingly handsome* but rather rare.

"IV. HETEROPHYLLÆ (*R. heterophylla*, the typical species of the section). Pileus fleshy, firm, with a thin margin, which is at first inflexed, then expanded and striate, covered with a thin, adnate pellicle. The gills consist of many shorter ones mixed with longer ones along with others which are forked. Stem solid, stout, spongy within.

"V. FRAGILES (*fragilis*, fragile or brittle). Pileus more or less fleshy, rigid-fragile, covered with a pellicle which is always continuous and in wet weather viscid and somewhat separable; margin membranaceous, at first convergent and not involute, in full-grown plants commonly sulcate and tubercular. Flesh commonly floccose, lax friable. Stem spongy, at length wholly soft and hollow. Gills almost all equal, simple, broadening in front, free in the pileus when closed. Several doubtful forms occur. *R. integra* is specially fallacious from the variety of its colors.

"* *Gills and spores white.*

"* * *Gills and spores white, then light-yellowish or bright lemon-yellow.*

"* * * *Gills and spores ochraceous.*"—STEVENSON.

I. COMPACTÆ.

1. "R. NIGRICANS, (Bull.) Fr., Hym. Eur., p. 439; Cke. 111, 1015; Stev., B. F., p. 114; Sacc., Syll., p. 453. Pileus 2–4 inches (5–10 centimeters) and more broad, olivaceous-fuliginous, *at length black*, fleshy to the margin which is at first bent inwards, convex, then flattened, umbilicato-depressed, when young and moist slightly viscid and even (without a separable pellicle), at length rimose-squamulose; flesh firm, white, when broken becoming red on exposure to the air. Stem 1 inch (2.5 centimeters) thick, persistently solid, equal, pallid when young, *at length black*. Gills *rounded* behind, slightly annexed, *thick*, *distant*, unequal, paler, reddening when touched.

"Compact, obese, inodorous within and without, *at length wholly black*, in which it differs from all others. The flesh becomes red when broken because it is saturated with red juice, although it does not exude milk. Sometimes a very few of the gills are dimidiate. In woods. Common. June–November. Spores papillose, 8μ. W. G. S. Coarse in habit. Name—*nigrico*, to be blackish. (Fr., Monogr., ii, p. 184; Berk. Out., p. 209; C. Hbk., n. 613; S. Mycol. Scot., n. 582; Hussey, i, t. 73; Ag. Bull., t. 579. f. 2, t. 212; Krombh., t. 70, f. 14, 15; Barla, t. 17; Sow., t. 36.)"—Stevenson.

Taste disagreeable. Massachusetts,* Frost; Minnesota, common, July and August, Johnson; New York, our specimens agree with the description in every respect, except that the gills are not distant, August and September, Peck, thirty-second report; New Jersey, Ellis.

2. "R. ADUSTA, (Pers.) Fr., Hym. Eur., p. 439; Stev., B. F., p. 114; Sacc., Syll., p. 454. Pileus pallid or whitish, *cinereous-fuliginous*, equally fleshy, compact, depressed then somewhat infundibuliform, margin at first inflexed, smooth, then erect, without striæ; flesh unchangeable. Stem solid, obese, of the same color as the pileus. Gills adnate, then decurrent, *thin*, *crowded*, unequal, white, then dingy, not reddening when touched.

"It can only be compared with *R. nigricans*, but is sufficiently distinct; stature commonly smaller, flesh juiceless, not reddening, etc. The pileus does not become black, but only of a scorched appearance. In woods. Frequent. August to October. 'Well distinguished by its thin, crowded gills,' etc. M. J. B. 'Spores sphæroid, echinulate, 7–9μ, globose, rough, 8.' C. B. P. Name—*aduro*, to scorch, from its scorched appearance. (Fr., Monogr., ii, p. 184; Berk. Out., p. 209; C. Hbk., n. 614; S. Mycol. Scot., n. 583; Ag., Pers. Krombh., t. 70, f. 7–11; Batt., t. 13.)"—Stevenson.

North Carolina and Pennsylvania, Schweinitz; North Carolina, woods and thickets, Curtis; Massachusetts, Frost; Minnesota, September and October, Johnson; California, Harkness and Moore; Nova Scotia, pine woods, September, Somers, R. J. Bennett.

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* These references are placed with regard to the order of their dates.

3. "R. DELICA, Fr., Hym. Eur., p. 440; Stev., R. F., p. 115; Sacc. Syll., p. 455. Pileus white, 3–5 inches (7.5–12 centimeters) broad, fleshy throughout, firm, umbilicate then infundibuliform, regular, everywhere even, smooth with a *whitish* luster, the involute margin without striæ; flesh firm, juiceless, not very thick, white. Stem curt, 1–2 inches (2.5–5 centimeters) long, ½ inch (12^{mm}) and more thick, solid, even, smooth, white. Gills *decurrent, thin, distant,* very unequal, white, exuding small watery drops in wet weather.

"The stature and *unchangeable colors* are wholly those of *L. vellereus* and *L. piperatus*, but it is readily distinguished *by the gills being juiceless*, though they exude watery drops when young. In mixed woods. Uncommon. September–October. Name—*delicus*, weaned; without juice or milk in the gills, as distinguished from *L. vellereus*, etc. (Fr., Monogr., ii, p. 185; Berk. Out., p. 210; C. Hbk., n. 615; S. Mycol. Scot., n. 585; Vent., t. 48 f. 3, 4; Batt., t. 17 A; Paul., t. 73 f. I,") Stevenson.

"Edible. Taste mild. Spores 8–10 by 6–8μ. Sacc., Syll. From the juiceless variety of *Lact. vellereus* its mild taste alone furnishes a separating character."—Peck.

A large, coarse species, cup-shaped at maturity. I have found it in several localities in Massachusetts in July and August. It is of fair quality, cooked, but much inferior to *R. virescens*, etc. Minnesota, in woods, August, Johnson; New York, Peck, 32d Report; California, Harkness & Moore.

4. "R. SORDIDA, Peck, 26th Rep. N. Y. State Mus. Nat. Hist., 1874, p. 65; Sacc., Syll., p. 459. Pileus 3–5 inches (7.5 centimeters) broad, firm, convex, centrally depressed, dry, sordid white, sometimes clouded with brown; gills close, white, some of them forked. Stem 4–5 inches (10–12.5 centimeters) long, ½–1 inch ($12–24^{mm}$) thick, equal, solid, concolorous; spores globose, .0003 inch (7.5μ); taste acrid, flesh changing color when wounded, becoming black or bluish-black.

"Ground under hemlock trees, Worcester, July.

"It resembles *L. piperatus* in general appearance. The whole plant turns black in drying.

"A large form of this species was found growing under hemlock trees at Gansevoort. The pileus was 4–8 inches (10–20 centimeters) broad, at first white or whitish, umbilicate or centrally depressed; then more or less stained with smoky-brown or blackish hues and subinfundibuliform. The flesh is white and taste mild; the stem is short, 1–2 inches (2.5–5 centimeters) thick, solid, white, and somewhat pruinose; the gills are distant, unequal, very brittle, tinged with yellow. Every part of the plant turns blackish or violaceous black where wounded. By this character it is distinguished from *R. nigricans*, in which the flesh at first becomes red where broken." 41st Rep. Peck. Found also in Ohio by Professor Morgan, under beech trees in hilly woods.

5. "R. COMPACTA, Peck, 32d Rep. N. Y. State Mus. Nat. Hist., 1879, p. 32. Pileus white, firm, solid, cracked in age, sometimes tinged with

red or yellow or both in spots, turning up in age, seldom depressed; lamellae very white, almost free, not forked or dimidiate, becoming brown when bruised or dry; stem solid, white, even, smooth; flesh at first white, then brownish."—Frost.

"Pileus 3–5 inches (7.5–12.5 centimeters) broad, fleshy, compact, convex or centrally depressed, whitish, sometimes tinged with red or yellow, becoming reddish-alutinaceous or dingy-ochraceous with age, the margin thin, even, incurved when young. Gills rather broad, subdistant, nearly free, some of them forked, a few dimidiate, white, becoming brown with age or where bruised. Stem 2–4 inches (5–10 centimeters) long, $\frac{2}{3}$–1 inch (16–24^{mm}) thick, short, equal, firm, solid, white, changing color like the pileus; spores subglobose, nearly even, .00035 inch (9μ) in diameter.

"Open woods. Sandlake and Brewerton. August and September.

"The late Mr. C. C. Frost sent me specimens and manuscript descriptions of a few species of fungi collected by him in Vermont. He gave names to those which he considered new species, and it gives me pleasure to adopt his names whenever it is rendered possible by the discovery of the species within our limits. The plant here described does not fully agree with his manuscript description, which I have quoted, but it approaches so near an agreement that there can not be much doubt of the specific identity of the two plants. In our plant the pileus is sometimes split on the margin. The change in the color of the pileus and stem is nearly the same, but the lamellae sometimes becomes darker than either. When drying, the specimens emit a strong and very disagreeable odor."—Peck. Massachusetts, Frost.

II. FURCATÆ.

6. "R. OLIVASCENS, Fr. Hym. Eur., p. 441; Sacc. Syll., p. 456. Pileus everywhere fleshy, expanded, umbilicate, *olivaceous*, the *disk becoming yellow*, margin even. Stem firm, even, pure white. Gills attenuated behind, crowded, almost equal, *white, becoming yellowish.* In frondose groves. This noble species should from its habit be placed among the *Furcatæ*, but the gills are more rarely forked and their form approaches that of the *Fragiles.* In several respects it agrees with the *Compactæ.*"—Fr.

Spores ochraceous. 8–10 by 6–8μ. Sacc. Syll. New York, in woods.

7. "R. FURCATA, (Pers.) Fr. Hym. Eur., p. 441; Stev., B. F., p. 116; Sacc. Syll., p. 456. Pileus about 3 inches (7.5 centimeters) broad, sometimes æruginous-greenish, sometimes umber-greenish, fleshy, compact, gibbous, then plano-depressed or infundibuliform, *even*, smooth, but often *sprinkled with slightly silky luster*, pellicle here and there separable, margin thin, at first inflexed, then spreading, always *even;* flesh firm, somewhat cheesy, white. Stem 2 inches (5 centimeters) or a little more long, solid, firm, equal or attenuated downwards, even, white. Gills *adnate-decurrent, rather thick*, somewhat distant but broad, attenuated

at both ends, frequently forked, shining white. Spores globose, echinulate, 6–7μ. C. B. P. Name, *furca*, a fork. With forked gills. (Fr. Monogr. ii. p. 187; Berk. Out. p. 210; C. Hbk. n. 616; S. Mycol. Scot. n. 586; Ag. Pers. Krombh. t. 62. f. I, 2, t, 69. f. 18–22; Bull. t. 26; Schaeff. t. 94; f. I. Barla t. 16, f. 1–9; Harz. t. 54, t. 63, f. 5; Paul. t. 74. f. 1; Buxb. C. v. t. 47, f. 2.")—Stevenson.

Taste, bitterish saline. This species has been considered poisonous, but later researches indicate that it is probably harmless. North Carolina and Pennsylvania common in grassy woods, Schweinitz; North Carolina, Curtis; Massachusetts, Frost; Minnesota, common in woods, September, Johnson; Wisconsin, Bundy; New Jersey, Ellis; Ohio, common, Morgan.

8. "R. SANGUINEA, (Bull.) Fr. Hym. Eur., p. 442; Stev., B. F., p. 116; Cooke, Ill., 1019; Sacc. Syll., p. 457. Pileus 2–3 inches (5–7.5 centimeters) broad, blood-red or becoming pale round the *even*, spreading, *acute margin*, fleshy, firm, at first convex obtuse, then depressed and infundibuliform and commonly globose in the center, polished, even, *moist* in damp weather; flesh firm, cheesy, white. Stem stout, spongy-stuffed, at first contracted at the apex, then equal slightly striate, white or reddish. Gills at first adnate, then truly decurrent, very crowded, very narrow, connected by veins, fragile, somewhat forked, shining white. Taste, *acrid*, peppery. Often confounded with *R. rubra*, which is of the same color, but entirely different from it in the firm, solid flesh, in the gills being adnate, then deeply decurrent, and acuminate in front. In woods, chiefly fir. Uncommon. August, September. Poisonous. Name, *sanguis*, blood. Blood-colored." (Fr. Monogr., ii, p. 188; Berk. Out., p. 210; C. Hbk. n. 617; S. Mycol. Scot. n. 587; Ag. Bull., t. 42.)

Minnesota, in woods, July, Johnson; Wisconsin, Bundy; California, Harkness & Moore; Nova Scotia, in pine woods, September, Somers.

9. "R. ROSACEA, Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Cooke, Ill., 1020; Sacc. Syll., p. 457. Pileus 2–4 inches (5–10 centimeters) broad, somewhat flesh-colored, varying in intensity, becoming whitish when the pellicle disappears, often *variegated with darker spots when dry*, compactly fleshy, at first convex, then expanded, obtuse, commonly *unequal*, repand, evenly incised, covered with a pellicle which is *viscid* and separable in wet weather, *margin acute*, even; flesh firm, cheesy, white. Stem about 2 inches (5 centimeters) long, solid, firm, at length spongy internally, even, smooth, occasionally ventricose, white or reddish. Gills in every stage of growth adnate, thin, crowded, fragile, forked behind, with dimidiate ones intermixed, always persistently white. Spores papillose, 7μ (W. G. S.). Name, *rosa*, a rose; rose-colored. (Fr. Monogr. ii, p. 188; Berk. Out., p. 210; C. Hbk., n. 618; S. Mycol. Scot., n. 588; Ag. Bull., t. 509, f. z.")—Stevenson.

Taste *slowly* acrid. Allied to R. *sanguinea*, but irregular, often eccentric, with the pileus somewhat repand, *scarcely depressed*, and the

gills less crowded, broader, less divided, *scarcely* connected. In mixed woods. Frequent. September, October.

Minnesota, July, Johnson; Rhode Island, Bennett.

10. "R. SARDONIA, Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Sacc. Syll., p. 458. Pileus 2–3 inches (5–7.5 centimeters) broad, reddish, etc., fleshy, compact, convex, then plane, rarely depressed, but here and there repand, with an adnate pellicle, which is viscid in wet weather, and soon changes color, and then often spotted, *margin even.* Stem 1½–2 inches (4–5 centimeters) long, almost 1 inch (2.5 centimeters) thick, solid, firm, but at length spongy within, even, white, or reddish. Gills adnate, *crowded*, broad, somewhat forked, *white*, exuding watery drops in wet weather, whence arise *yellowish* spots when dry. Robust, firm. The color is very changeable, sometimes reddish, sometimes pallid with yellow spots, sometimes dingy yellow, opaque. Flesh same as in *R. rosacea*, etc. Intermediate between *R. rosacea* and *R. expallens*, but distinct from both in color, becoming yellow.

"In woods, chiefly fir. Uncommon. September.

"Name—from its acrid taste—*Herba sardonia* (probably *Ranunculus sceleratus*), screwing the mouth with its bitterness. (Fr. Monogr. i. ip. 189; Berk. Out. p. 211; C. Hbk. n. 619; S. Mycol. Scot., n. 589; Ag. Krombh. t. 68, f. 1–4; Schaeff. t. 16, f. 5, 6.") Stevenson.

Spores, 8–16 by 8μ. Sacc. Syll. Minnesota, July, Johnson; Wisconsin, Bundy.

11. "R. DEPALLENS, (Pers.) Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Cooke, Ill., 1021; Sacc. Syll., p. 458. Pileus pallid reddish or inclining to fuscous, etc., fleshy, firm, convex, then plane, more rarely depressed, but commonly *irregularly shaped and undulated*, even, the thin adnate pellicle presently changing color, especially at the disk, the spreading margin even, but slightly striate when old; flesh white. Stem about 1½ inches (4 centimeters) long, solid, firm, commonly attenuated downwards, *white, becoming cinereous* when old. Gills adnexed, broad, crowded, distinct, but commonly forked at the base, often with shorter ones intermixed. Inodorous, taste mild. The color of the pileus is at first pallid reddish, or inclining to fuscous, then whitish or yellowish, opaque in every stage of growth. It approaches nearest to the *Heterophyllæ*.

In beech woods, pastures, etc. Uncommon. August–September.

Name—*de*, and *palleo*, to be pale. Becoming pale. (Fr. Monogr. ii. p. 189; Berk. Out. p. 211; C. Hbk. n. 620; S. Mycol. Scot. n. 590; Krombh. t. 66, f. 12, 13.") Stevenson.

Edible. North Carolina and Pennsylvania, in pine woods, Schweinitz; North Carolina, in pine woods, Curtis; Minnesota, in thin woods, July Johnson; Wisconsin, Bundy; Nova Scotia, under spruce, Somers.

(*To be continued.*)

NEW WESTERN FUNGI.

By J. B. Ellis and B. T. Galloway.

Phoma thermopsidis, *n. s.* On dead stems of *Thermopsis rhombifolia.* Helena, Mont. Summer of 1888, F. D. Kelsey, Com. F. W. Anderson, No. 413. Perithecia gregarious, subcuticular raising and rupturing the epidermis, but hardly erumpent, subhemispheric with papilliform ostiolum. Sporules oblong-hyaline 2-nucleate, not curved, 15–20 by 5–6μ.

Phleospora oxytropidis, *n. s.* On *Oxytropis Lamberti.* Great Falls, Montana, June, 1888. F. W. Anderson, No. 258. Perithecia amphigenous, innate-erumpent, about 200μ in diameter, scattered, black. Sporules cylindrical or ovoid, 40–50 by $3\frac{1}{2}$–$4\frac{1}{2}\mu$., hyaline, straight, obtuse, nucleate, issuing in a whitish mass.

Pestalozziella Andersoni, *n. s.* On living leaves of *Asclepias* or *Apocynum.* Sand Coulee, Mont. September, 1888. F. W. Anderson, No. 289, Acervuli amphigenous, thickly scattered over the leaf, black, erumpent, discoid, 150–200μ in diameter. Sporules ovate-elliptical, subacute, hyaline, continuous, 15–22 by 7–10μ, with an irregularly branched hyaline, 3-4-parted crest of spreading bristles or hairs 12–15μ long, much as in *Pestalozziella subsessilis*, S. & E. The basidia also are obscure or wanting, as in that species. The affected leaves turn yellow and then brown.

Dicoccum lathyrmum, *n. s.* On living leaves of *Lathyrus ochroleucus*, Highwood Cañon, in the Highwood Mountains, Montana, Leg. R. S. Williamson, Com. F. W. Anderson, No. 301. Conidia oblong, 1-septate, slightly constricted, straight, olivaceous, granular, 20–22 by 7–8μ, forming small, subconfluent, chestnut-colored, velutinous patches on the under side of the leaves (2–3^{mm} in extent), limited by the veinlets, not on any definite spot, but causing the leaf to turn slightly yellowish above. There is no appreciable mycelium, at least on the surface of the leaf.

Peziza yogoensis, *n. s.* On dead leaves of *Carex.* Yogo, in the Belt Mountains, Montana, July, Leg. 1888, R. S. Williamson, Com. F. W. Anderson, No. 317. Erumpent of fibrous texture, 200μ in diameter, margin fimbriate and incurved, substance of the perithecia olivaceous. Disk pale, asci oblong, 55–60 by 15–18μ, sessile, paraphyses stout, about equal to the asci; not abundant. Sporidia oblique or biseriate, oblong, 2-nucleate, hyaline, rounded at the ends and a little narrower at one end, not curved, 13–15 by 4–5μ.

On the same leaves is a *Sphærella*, with gregarious perithecia, oblong, inequilateral, 35 by 12μ, sessile asci, and crowded biseriate, oblong 12–15 by $3\frac{1}{2}$–4μ, sporidia. Very near *S. Wichuriana*, Schrœt.

Epicoccum rubripes, *n. s.* On dead herbaceous stems, Montana. Anderson, No. 290. Sporodochia gregarious, hemispheric, black, $\frac{1}{4}$–$\frac{1}{2}^{mm}$

in diameter, covered above with a layer of obovate, subolivaceous, roughish, substipitate conidia, 7–15μ in diameter, substance of the inner and lower part of the sporodochia rose-red.

The general appearance is that of some erumpent *Sphæria.*

SPHÆRELLA AQUILEGIÆ, *n. s.* On *Aquilegia Jonesii*, Yogo, in the Belt Mountains, Helena, Montana. July, 1888, Leg. R. S. Williamson, Com. F. W. Anderson, No. 299.

Perithecia scattered on the leaves and petioles, erumpent, rather acutely hemispherical, black, 100–120μ. in diameter, pierced above, and more or less distinctly fringed at base with brown creeping threads, texture coarsely cellular. Asci obovate-oblong, sessile, 50–60 by 22–25μ, inequilateral, without paraphyses. Sporidia crowded-biseriate, subclavate-oblong, hyaline, straight, obtuse, slightly constricted, 20–22 by 9–11μ, each cell 1–3-nucleate. Differs from *S. pachyasca*, Rostrop, which is also found in Montana on *Phlox cæspitosa*, principally in its broader sporidia. Perhaps this might be considered a form of that species.

PLEOSPORA LAXA, *n. s.* On dead leaves and culms of some grasses. Montana, Anderson, No. 348. Perithecia scattered, subglobose, black 150–170μ. in diameter, their bases projecting on one side of the lamina of the leaf and their apices on the other. Asci few (6–8), in a perithecium, inflated-oblong, broadly rounded above, and contracted at the base into a short stipe, 150–200 by 35–55μ. Paraphyses obscure. Sporidia 8, in an ascus, obovate, oblong, 6–8-septate, coarsely muriform, deeply constricted near the middle, so as easily to break in two at the constriction, straw-yellow, 35–45 by 15–20μ (mostly 15μ wide). This seems to differ from any of the other described species on grasses or *Carices* in its strongly constricted spores. This character is very distinct through all stages of growth.

The constriction is generally at the third septum from the upper end of the spore, the part above this constriction being broader and shorter (often nearly globose) than the part below it. This comes near *P. Islandica*, Johans, but differs in its more obtuse and deeply constricted sporidia.

LEPTOSPHÆRIA SPOROBOLI, *n. s.* On dead culms of *Sporobolus depauperatus*, Sand Coulee, Cascade County, Mont., August, 1887. F. W. Anderson, No. 233.

Perithecia scattered, erumpent-superficial subhemispherical, nearly smooth, black, $\frac{1}{5}$–$\frac{1}{4}^{mm}$ in diameter, with a short, thick, nipple-like ostiolum. Asci clavate-cylindrical 75–80 by 16–18μ, with abundant paraphyses. Sporidia crowded-biseriate, overlapping each other, oblong-fusoid, ends subobtuse, straight, 6-septate, and not at all or finally slightly constricted at the septa, about 22 by 7μ, straight or nearly so. Differs from *L. culmifraga*, to which it is closely allied in its shorter and quite constantly only 6 septate sporidia, and from *L. culmicola* in its superficial growth.

Didymosphæria euryasca, *n. s.* On dead leaves of *Pinus Murrayana.* Summit of Mt. Helena, Lewis and Clarke County, Mont. September, 1887. F. W. Anderson, No. 403. Perithecia scattered, suberumpent, minute 80–100μ, perforated above. Asci inequilaterally ovate, sessile, 35–40 by 12–15μ. Paraphyses? Sporidia bi-triseriate ovate-oblong, 1-septate, constricted, rounded at the ends, brown, 12–15 by $3\frac{1}{2}$–5μ. The perithecia are only partially erumpent, remaining partly covered by the epidermis.

Puccinia mutabilis, *n. s.* II and III. On *Allium mutabile,* Sand Coulee, Mont., June, 1888. Anderson, No. 446. Sori suborbicular or elliptical, small, $\frac{1}{2}^{mm}$ in diameter, covered at first by the epidermis, soon exposed and chestnut-brown, sometimes more or less confluent. Uredospores, pale, faintly aculeolate, globose or elliptical 18–22 by 15μ. Teleutospores, ovate or elliptical obtuse and rounded, and moderately thickened above, distinctly constricted, narrowed below (in the ovate form) into the rather stout hyaline pedicel, which is a little shorter than or about as long as the spore. This differs from *P. alliorum,* Cda., *P. porri,* (Sow.) Winter, and *P. scillæ,* Linhart, in its shorter, obtuse spores.

Sporidesmium macrosporoides, *n. s.* On stems of *Artemisia tridentata.* Glendale, Mont., October, 1888. F. W. Anderson, No. 391. Forming orbicular or subelongated disks 1–3^{mm} in diameter, at first covered by the white tomentose coating of the stem, then bare and black, appearing as a slightly elevated disk or flattened tubercle, the lower stratum of which is composed of the closely compacted hyphæ changed into a subgrumous mass and giving rise to a superficial layer of conidia which are at first oval or subglobose and subhyaline, but soon become dark and 1-septate or oftener sarcinuliform, *i. e.,* subglobose 8–12μ in diameter, and divided into 4 cells by two septa at right angles to each other. These 4-celled conidia soon increase in size by the formation of additional cells till they finally simulate more or less perfectly the form of the conidia of *Macrosporium,* clavate or obovate with 3–4 transverse septa and one or more longitudinal septa forming an olive brown conidium 30–40 by 18–20μ, without any distinct pedicel. Var. *gummosum,* on twigs of *Betula alnifolia* (Anderson, 294), is preceded by a gummy exudation in the form of a small transparent globule and has the conidia more irregular in shape.

Septosporium heterosporum, *n. s.* On living leaves of *Vitis Californica,* near Orange, Cal. Prof. F. L. Scribner, October, 1887. Spots scattered and more or less confluent, indefinitely limited, rusty brown above, $\frac{1}{2}$ to 1 centimeter in diameter, smoky black below or appearing gray on account of the tomentum of the leaf.

Hyphæ hypophyllous, issuing in fascicles from the stomata of the leaf and bearing at their apices the very variable conidia, which are at first oblong-cylindrical, 2–3 septate, 20–40 by 5–7μ, like the conidia of a *Cercospora.* These conidia soon become constricted at the septa and each of the three or four cells become uniseptate. The three primary septa

gradually become deeper until the conidia finally separate into three or four separate uniseptate segments of a short elliptical or nearly spherical shape, about 12μ in diameter, with the epispore distinctly roughened. We have compared this with specimens of *Septosporium Fuckelii*, Thüm., as represented in de Thümen's Mycotheca Universalis, 671, and with specimens collected in Algeria by Professor Viala. The California specimens differ in their much shorter hyphæ and very different conidia, which are much constricted at the septa. Plate X, Figs. 5 and 6.

NEW SPECIES OF HYPHOMYCETOUS FUNGI.

By J. B. Ellis and Benjamin M. Everhart.

Oidium pirinum, *n. s.* On leaves of *Pirus coronaria*, Racine, Wis., June, 1888. Dr. J. J. Davis, No. 31. Spots large, occupying a large part of the leaf, light brown, with definite, rather irregular outline, finally spreading over and killing the entire leaf. Conidia subglobose, with the surface slightly uneven, hyaline 12–16μ in diameter, closely concatenate in series of 3–4, the lower one supported on a slender basidium 10–12μ long. A portion of this basidium remains attached to the lower conidium as a short pedicel. The prostrate sterile hyphæ are either wanting or at least not conspicuous, the abundant pulverulent, light-cinereous conidia, which are mostly on the upper surface of the leaf, being the most conspicuous feature.

Ovularia compacta, *n. s.* On living leaves of *Macrorhyncus troximoides.* Wet mountain valley, Colorado, July, 1888. Demetrio, 182. Spots amphigenous, subelliptical, 1^{cm} in diameter, light brown or buff. Hyphæ simple, continuous, 15–25 by 4μ, slightly toothed above or entire, forming dense tufts and bearing at their tips the ovate 12–15 by 5–6μ conidia.

Langloisula. A new genus of *Mucedineæ.*

Hyphæ prostrate, much branched and interwoven, forming a loose, submembranaceous layer, and bearing the large solitary conidia at their extremities. Differs from *Monosporium* in the absence of any erect fertile hyphæ and from *Monilia* in its solitary conidia.

Langloisula spinosa, *n. s.* Growing around the base of the culms of *Andropogon muricatum* (in gardens). St. Martinville, La., January, 1889. Langlois, 1641.

Forms a thin, light-yellow layer like a *Corticium*, finally becoming of a deeper color (tawny-yellow) and subpulverulent, breaking up into frustules like *Corticium scutellare* B. & C., and falling off. The fungus is made up of prostrate yellow hyphæ 2–3μ in diameter, repeatedly dichotomously branched, the ultimate branches short, subulate or spiniform, bearing the globose or oval yellow conidia 12–14 μ in diameter in a loose layer partially covering the subjacent hyphæ. The ultimate

branching of the threads reminds one of the sporophores of some of the *Peronosporeæ*. The general appearance is exactly that of a thin yellow *Corticium* like N. A. F. 657 ("*Gonytrichum fulvum*"), which we now think is only an imperfectly developed state of *Corticium cervicolor*, B. & C., being in fact only the lower sterile stratum of that species. The conidia in the Louisiana fungus resemble those of a *Monilia* in having a short appendage resembling the connecting cell between the spores in that genus, but we can not make out that the conidia are concatenate, the short appendage being rather of the nature of a pedicel. Plate X, Figs. 1 and 2.

RAMULARIA BRUNELLÆ, *n. s.* On living leaves of *Brunella vulgaris*. Racine, Wis., August, 1888. Dr. J. J. Davis, No. 9. Spots large, dark brown, more or less distinctly concentrically zoned above, rather indefinitely limited, more or less confluent so as often to cover nearly the entire leaf. Hyphæ hypophyllous, short, 10–15 by $2\frac{1}{2}\mu$, hyaline, mostly toothed above, forming minute white scattered tufts, scarcely visible. Conidia oblong-cylindrical, continuous, 10–15 by $1\frac{1}{2}$–$3\ \mu$.

RAMULARIA SEROTINA, *n. s.* On leaves of *Solidago serotina*. Lake County, Ill., July, 1888. Dr. J. J. Davis, No. 39. Spots amphigenous, 1–5^{mm} (mostly 2–3^{mm}), pale yellow-brown, with a narrow, definite, darker margin; sometimes confluent (1^{cm} or more), of somewhat irregular shape, but the smaller ones suborbicular. Hyphæ amphigenous, fasciculate subnodulose, and toothed above, continuous or faintly 1–2-septate, hyaline, 25–30 by 3μ. Conidia oblong-cylindrical, hyaline, 1-septate, 15–28 by 3μ, subconcatenate. On account of the definite spots and quite constantly 1-septate conidia this is different, from *R. virgaurea*, Thüm., which pertains to *Cercospora*, often having the conidia 50–75μ long.

RAMULARIA VIBURNI, *n. s.* On living leaves of *Viburnum lentago*. Racine, Wis., June, 1888. Dr. J. J. Davis, No. 27. Spots amphigenous, rusty brown (greenish-brown at first) 4–5μ in diameter, suborbicular, with a darker margin. Hyphæ amphigenous 12–20 by $2\frac{1}{2}$–3μ, hyaline, tufts erect, simple. Conidia fusoid-cylindrical, slightly curved, 1–3 septate, 20–40 by $1\frac{1}{2}$–2μ, yellowish-hyaline. Resembles *R. andromedæ*, E. & M., but is amphigenous, and the conidia are longer and have a greater number of septa.

CONIOSPORIUM CORTICALE, *n. s.* In bark of maple logs, London, Canada. Prof. J. Dearness, No. 2. Forms a brownish-black dusty stratum between the lamina of the bark. Conidia globose 3–4μ in diameter or elliptical or ovate-elliptical $4\frac{1}{2}$–5 by 3–4μ. The globose conidia comparatively few. This must come near *C. aterrimum*, Cda., but we think it different, though we have no specimen of that species.

FUSICLADIUM BREVIPUS, *n. s.* On leaves of *Astragalus hypoglottis*. Musie Pass, Sangre de Christo Range, Colorado, July, 1888. Demetrio, 199. Hypophyllous, forming small, scattered or subconfluent mouse-colored or smoky olivaceous patches scattered over the lower face of the leaf. Hyphæ, consisting of collections of subovate, brownish cells

8–12 by 5–7μ, from the tops of which arise the elliptical or oblong 25–55 by 8–11μ conidia, of an olivaceous brown color, at first continuous, then 1–2 septate, the longer ones attenuated below into a stipe like base. Approaches *Cercospora*.

CLASTERISPORIUM CÆSPITULOSUM, *n. s.* On rotten maple wood. Newfield, N. J., 1879. Conida fusoid-cylindrical, 12–20 septate, 100–120 by 12–15μ, subattenuated above, but with the apex distinctly rounded, abruptly contracted below, with a short stipe-like base attached directly to the wood without any perceptible prostrate threads. The conidia are nearly opaque, straight and erect, not constricted at the septa, but some of them are contracted near the middle. They grow in loose fascicles, which are more or less crowded, forming black tomentose patches or subeffused. Nearly allied to *C. larvatum*, C. & E., but differs in its *straight* conidia with short stipitate base.

HETEROSPORIUM HYBRIDUM, *n. s.* On dead stems of *Cleome integrifolia.* Helena, Mont., August, 1888. Rev. F. D. Kelsey, No. 137. Subcuticular, then erumpent, forming grayish-olive oblong, velutinous patches (2–3 by 1–2^{mm}), or by confluence 1^{cm} or more. Hyphæ erect, simple or sparingly branched; septate 100μ long or over, and 5–7μ thick. Conidia elliptical or oblong-elliptical, 1–2 septate (mostly only 1 septate), minutely hispid, slightly constricted at the septum. There are also regular Macrosporium conidia (apparently arising from the same hyphæ), clavate-obovate, pedicellate, about 4 septate, 15–50 by 10–15μ, the longer ones muriform. From its ambiguous character this is an unsatisfactory thing.

HETEROSPORIUM FUNGICOLUM, *n. s.* On old *Polyporus picipes.* Lincoln, Nebr. H. J. Webber. Olivaceous. Hyphæ 115–150 by 5–6μ, abruptly bent and crooked above, bearing laterally and terminally the oblong elliptical yellowish-brown 1–3-septate, minutely echinulate, 12–25 by 7–12μ conidia.

CERCOSPORA SYMPHORICARPI, *n. s.* On *Symphoricarpus vulgaris.* Rooks County, Kans. Mr. E. Bartholomew, 227 B. Hypophyllous, on small (1–2^{mm}), deep rust-colored round spots. Hyphæ fasciculate 30–40 by 3μ, continuous, brownish, denticulate above. Conidia clavate-oblong 20–30 by 3 μ; 1–3 septate.

CERCOSPORA VIRIDULA, *n. s.* On leaves of *Ipomea purpurea.* (Convolvulus.) Concordia, Mo., October, 1888. Rev. C. H. Demetrio, 214. Spots suborbicular ($\frac{1}{2}$–$\frac{3}{4}^{cm}$), rather indefinitely margined, dirty brown above, paler and greenish-brown below. Hyphæ epiphyllous, 25–35 by 4μ, pale brown, continuous, shouldered above, rising in small fascicles from a scanty tubercular base, thickly scattered on the spots, but inconspicuous. Conidia subcylindrical but narrowed above, subhyaline, 6–8-septate, 70–80 by 4μ. Differs from *C. ipomϾ*, Winter, in its more indefinite and larger spots and shorter conidia.

CERCOSPORA DUPLICATA, *n. s.* On large (4–6^{cm}) dark, dirty brown, irregular shaped spots on leaves of *Tecoma radicans.* St. Martinville, La., October, 1888. Langlois, 1549. Hyphæ epiphyllous, very short

(8–10μ), on a small (30–35μ) tubercular base, bearing at their apices the linear-lanceolate, subhyaline, faintly 3–6-septate 30–60 by $2\frac{1}{2}$–3μ conidia. The spots are at first of a reddish-purple tint. This is entirely different from *C. sordida*, Sacc., an olivaceous effused species which was observed on the under side of the same leaves.

CERCOSPORA DOLICHI, *n. s.* On leaves of *Dolichos sinensis.* Starkville, Miss., September, 1888. Prof. S. M. Tracy. Amphigenous, but more abundant below. Hyphæ short 20–25 (exceptionally 30–35) by 4–5μ, olivaceous, entire or slightly toothed above, continuous or with one or two obscure septa, forming small but close tufts without any distinct tubercular base, the tufts scattered over almost the entire surface of the leaf both on the reddish spots and on the green parts of the leaf, but unevenly distributed, so as to present a clouded or mottled appearance. Conidia slender obclavate, hyaline, 3–5 or more septate, 50–100 by $3\frac{1}{2}$–4. The spots are much like those of *Amerosporium œconomicum*, E. & T. (J. M. IV. p. 102), only not white, but rusty-red, or at most only whitish.

CERCOSPORA SII, *n. s.* On leaves of *Sium cicutæfolium.* Racine, Wis., September, 1888. Dr. J. J. Davis, No. 62. Mostly hypophyllous, in small (2–3^{mm}) but dense patches, but finally confluent, so as often to cover nearly the entire surface of the leaf, which is more or less mottled and stained yellowish, black above. Hyphæ loosely fasciculate, smoky, or olivaceous-hyaline, 40–60 by 5μ, strongly shouldered and toothed above, continuous or sparingly septate. Conidia lateral and terminal, oblong-cylindrical, mostly 1-septate, very slightly curved, granular, 20–45 by 5–7μ (mostly 30–40 by 6–7μ).

CERCOSPORA AGERATOIDES, *n. s.* On living leaves of *Eupatorium ageratoides.* Newfield, N. J., July to September, 1885. Hypophyllous. Tufts effused, forming olivaceous, velvety patches 1–3^{mm} in diameter, subangular and bounded by the veinlets of the leaf, finally confluent and nearly tobacco-brown. Hyphæ in minute tufts of 5–8 together, simple, septate, brown, subundulate above 50–90 by 4μ. Conidia cylindrical or lanceolate, 40–75 by $3\frac{1}{2}$–5μ, 4–6 septate, pale olivaceous. Closely allied to *C. clavata*, Ger. The color and habit are much the same but besides the different host plant, this has the hyphæ longer and in tufts less dense, and the conidia, though of the same general character, not as variable in length and mostly narrower. On the same leaves are light colored subangular spots, also limited by the veinlets of the leaf, but they do not produce the *Cercospora.* In a var. of this (?) on *E. album*, the light-colored spots are wanting, the hyphæ mostly shorter (40μ.) and the conidia rather longer (70–80μ) and narrower (3μ).

CERCOSPORA PERFOLIATA, *n. s.* On living leaves of *Eupatorium perfoliatum.* Racine, Wis., September, 1888. Dr. J. J. Davis, No. 64. Hypophyllous. Hyphæ decumbent, with their free ends ascending, 30–40 by 4–5μ, nucleate, continuous, brownish, subentire and obtuse above, effused in suborbicular brown patches, not definitely lim-

ited and finally more or less confluent. The leaf is marked above with yellowish blotches, which finally become dark brown. Conidia *oblong*, pale tobacco-brown, nucleate becoming 1-septate, 20–35 by 5–6μ. The mode of growth is like that of *C. clavata*, Ger. Both this and *C. ageratoides*, E. & E., differ from *C. eupatorii*, Pk., which is on definite spots.

CERCOSPORA SIDÆCOLA, *n. s.* On living leaves of *Sida spinosa* St. Martinville, La., December, 1888. Rev. A. B. Langlois, No. 1555. Forming smoky black indefinitely effused velutinous patches on the under side of the leaf, the upper side remaining green or only slightly discolored. Hyphæ scarcely tufted, simple, multiseptate, reddish-brown (under the microscope), repeatedly shouldered above, slender, 150–225 by about 4μ. Conidia slender, obclavate, hyaline, granular and nucleate, becoming faintly 5–7-septate, 70–100 by 4–5μ.

CERCOSPORA FUSCO-VIRENS, Sacc. Prof. S. M. Tracy finds this at Madison, Miss., on *Passiflora incarnata* with hyphæ 40–50 by 4–5μ. Conidia 80–120 by 3–4μ. Are the measurements in Sylloge transposed? It would appear so from these specimens, which agree otherwise with Saccardo's description.

SPORIDESMIUM INSULARE, *n. s.* On bark of living oak. Flatbush, L. I., N. Y., December, 1888. Rev. J. L. Zabriskie, 52. Forming small, black, scattered patches, about as large as a pin-head, or more or less confluent, bursting through the sterile, granular thallus of some lichen. Conidia arising from slender, subhyaline inconspicuous creeping threads, at first globose, and as in *S. sarcinula*, B. & C., marked by two septa at right angles, soon enlarged by the addition of a margin of peripheric cells and becoming 12–15μ in diameter; when growing beyond this size they usually become oblong 25–40 by 15–20μ, more or less irregular in shape. The component cells are about 3μ in diameter. We have not seen *S. epicoccoides*, B. & C., from which possibly this is not distinct. The conidia under the microscope remind one of *Cheirospora botryospora*, Fr.

DENDRODOCHIUM NIGRESCENS, *n. s.* On bark of *Acer negundo*. Sand Coulee, Cascade County, Mont., November, 1888. F. W. Anderson. Sporodochia erumpent, about 1^{mm} across, flesh color, becoming nearly black. Basidia dichotomously or subverticillately branched, mostly curved. Conidia oblong, hyaline, 5–7 by $1\frac{1}{2}$–2μ.

NEW SPECIES OF FUNGI.

By W. A. KELLERMAN and W. T. SWINGLE.

SACIDIUM ULMI-GALLÆ, *n. s.* Spots none; pseudo-perithecia occupying indefinite blackened portions of the outside of the gall, rather few, subgregarious, indistinctly limited, black or dusky black, oval, elliptical or irregularly linear, $\frac{1}{2}$–2 by $\frac{1}{4}$–$\frac{1}{2}^{mm}$, at first irregularly inflated, then depressed and corrugated, very early splitting nearly the whole length

and finally exposing nearly the whole hymeneal layer by the free edges approaching the sides in a compact roll; formed from the blackened and slightly changed cuticle of the host; on the upper surface granulate, below irregularly tuberculate, not distinctly cellular; basidia hyaline, clavate, cylindrical or somewhat irregular, continuous or sometimes apparently sparingly septate, very numerous, densely crowded, 15–25 by 2–4μ; sporules hyaline, ovate, clavate, cylindrical or sometimes oblong or oval, attached by the smaller end, bluntly rounded at both ends, often slightly inequilateral, $7\frac{1}{2}$–11 by 3–5μ, mostly 8–10 by $3\frac{1}{2}$–$4\frac{1}{2}\mu$, wall very thin, smooth, contents minutely many-guttulate, especially at the ends. On galls caused by some species of *Phytoptus* on the upper side of the leaves of *Ulmus Americana*, Manhattan, Kans., May and June, 1889. (No. 1493.) The basidia of this species are formed between the epidermal cells and the cuticle in almost exactly the same way as in some species of *Taphrina*. The mycelium is formed, chiefly between the cells, for a considerable distance from the perithecia. It is hyaline, many septate, rather coarse, and often much twisted and contorted. This species differs from most of the *Saeidii* in having, apparently, no true perithecium. However, the related genus *Leptothyrum* has such species.

The galls which it attacks are not those caused by *Phytoptus ulmi*. They are much larger and differ in shape from the galls caused by that species. They are "nail galls" about 5–10 by 2–4^{mm}, usually acute or subacute at the top and abruptly narrowed and nearly closed at the base The sides are usually more or less angled or ribbed; often several galls become attached to each other or spring from a common base without becoming attached above.

Cylindrosporium triostei, *n. s.* Spots indefinite, amphigenous but more prominent above, yellowish green, at first small ($\frac{1}{2}$–2^{mm} in diameter), sometimes at length becoming confluent and from 2–5^{mm} in diameter. Usually sparse, scattered irregularly all over the leaf; acervuli, amphigenous, but often larger and more numerous below, sparse, at first subepidermal then erumpent, about 150–300μ in diameter, pale yellowish white; hyphae pallid, abundant, rather irregularly and sparingly branched, variable in diameter, often larger above, about 15–30 by 3–5μ, arising from a dense pseudo-parenchymatous mass of hyphae which at first issue through the stomata but soon force themselves through the epidermis all around finally pushing it away; conidia terminal on the hyphae or branches, subpersistent, abundant, in mass of a pale cream color, when seen singly subhyaline, elongate-fusoid, very strongly and regularly curved or rarely only slightly curved, ends rather obtuse or sometimes acute, the free end being the most acute, 3–7 (mostly 4–6) septate, not constricted at septa, rather regular in size, 35–67 by 4–6μ, mostly 45–57 by 4–5μ. Very rare on leaves of *Triosteum perfoliatum*. Manhattan, Kans., August 24, 1887. This species seems to be extremely rare, a few specimens were seen and conidia

sketched in 1886 but none were collected in any quantity till the following year. It is more abundant on the lower leaves but occurs also on the upper ones. The mycelium is very abundant, hyaline, somewhat branched and sparingly septate, about $2\frac{1}{2}$–$3\frac{1}{2}\mu$ in diameter. The conidia are often curved so as to form a semicircle and sometimes even still more curved; sometimes one end is more curved than the other. Owing to this fact of the conidia, and especially the longer ones, being so much curved they are in reality much longer than is shown by the measurements given.

CERCOSPORA AQUILEGIÆ, *n. s.* Spots distinct, about equally prominent on both sides of the leaflets, purplish brown, paler below, rather numerous, scattered over the leaf or sometimes confluent, variable in size, about 3–15^{mm} long and $1\frac{1}{2}$–5^{mm} wide, usually irregularly linear or oblong but sometimes nearly square when young, angular, often acutely pointed, limited by the veinlets; hyphæ sparsely scattered, dusky, simple, usually several septate, not at all or only slightly constricted at septa, tapering scarcely if at all or sometimes even slightly larger above, below nearly straight but towards the tip usually several times strongly geniculate and dentate, occasionally bent nearly at right angles, rather long, 50–145 by 4–$6\frac{1}{2}\mu$, mostly 80–110 by 5–6μ, often growing in small tufts which are composed of 2–6 loosely diverging hyphæ, and are scarcely noticeable except in section; conidia scarce, hyaline, more or less curved, flagellate, attached by the larger blunt end, the free end being very slender and acutely pointed, rather indistinctly multiseptate, scarcely or not at all constricted at septa, variable, often very long, 140–310μ long, $4\frac{1}{2}$–6μ in diameter at the base, and $1\frac{1}{2}$–3μ in diameter at the apex, mostly 150–250μ long, 5–6μ in diameter below, and 2–$2\frac{1}{2}\mu$ in diameter above. On radical leaves of *Aquilegia Canadensis*, Manhattan, Kans., June 21, 1889. (No. 1495.) This species is really distinguished from any published species occurring on *Ranunculaceæ* by its strongly bent hyphæ and very long conidia. The mycelium is sparse, hyaline, sparingly branched, sometimes guttate, 2–3μ in diameter. The conidia are sometimes rather variable in diameter towards the base, one or more of the segments being more slender than the adjoining ones.

CERCOSPORA GERANII, *n. s.* Spots visible on both sides of the leaf, brownish or dusky, oval or oblong or sometimes sublinear, often marginal or terminal sometimes limited by prominent veins, very often surrounded by a pale, but rather clear red coloration which is more prominent on the upper surface of the leaf and often involves more or less of the whole segment of the leaf especially the part beyond the spot and on the same side of the midvein, 2–8 by $1\frac{1}{2}$–4^{mm} mostly 3–7 by 2–3^{mm}; tufts amphigenous, but rather more abundant above, thickly and evenly scattered over the whole spot, rather small, deep seated, usually arising through stomata, composed of from 5–15 or even 20–30 hyphæ, which are densely packed below the surface, but considerably divergent above; hyphæ short and stout, dusky or brownish, 25–50μ

long, 3–4μ in diameter at base and 3–3$\frac{1}{2}\mu$ in diameter at apex, mostly about 30–40μ long, simple, sparingly septate at base, often somewhat bent at the tip and showing several closely proximate scars where conidia were attached; conidia abundant, persistent, hyaline, straight or slightly curved, cylindrical or, when very long, clavate, acute at both ends, attached by the larger end (?), plainly 1–5, mostly 3–4, septate, not constricted at septa, quite variable in size, and especially in width, 36–98μ long, 1$\frac{3}{4}$–3μ in diameter at base and 1$\frac{1}{4}$–3μ in diameter at apex, mostly 48–85μ long, 2$\frac{1}{4}$–3μ in diameter at base and 1$\frac{1}{2}$–3μ in diameter at apex. On languishing lower leaves of *Geranium Carolinianum*, St. George, Pottawatomie County, May 30, 1887 (No. 898). The conidia in this species are remarkably abundant and persistent, and in good specimens may be seen attached to the hyphæ in such great numbers as to form a thin whitish coating over the spot. The tufts are quite variable in size and appear as minute black dots before the conidia are fully formed or after they have fallen. The mycelium is rather sparse, hyaline, rather regular in diameter (2$\frac{1}{2}$–3μ), but sparingly if at all septate.

CERCOSPORA GAURÆ, *n. s.* Spots amphigenous, definite, subolivaceous, surrounded by an indefinitely reddish coloration, suborbicular, oval, or rounded angular, about 5–10^{mm} in diameter, often limited by a vein on one side; tufts mostly epiphyllous but usually amphigenous, at first small, composed of few hyphæ, but becoming large (40–100μ in diameter), composed of hyphæ which are closely packed or slightly divergent; hyphæ short, simple, continuous, subfuscous, tapering slightly from the base, 15–30 by 2$\frac{1}{2}$–4μ, mostly 18–25 by 3–4μ; often dentate above, and sometimes bent or strongly dentate below; conidia of the same color as the hyphæ, slightly curved or straight, linear clavate, the larger attached ends subacute truncate, the free ends somewhat acute, when young nucleate, when mature 3–7 septate, 40–108 by 2–4μ, mostly 56–90 by 1$\frac{1}{2}$–3μ. On leaves of *Gaura biennis*, Columbus, Kans., July 12, 1887 (No. 1491). The nuclei in the young conidia appear to be in pairs on either side of the places where septa will appear.

CERCOSPORA LOBELIÆ, *n. s.* Spots visible on both sides of the leaf but more prominent above, light grayish or pallid dirty yellowish, at first minute, suborbicular then larger, 3–8^{mm} in diameter, oval or suborbicular, often subangular and sometimes irregular, surrounded by an indefinite dull purplish coloration, which is more pronounced around the smaller spots. Tufts scattered amphigenous but often more abundant below, composed of 10–20 or more laxly diverging hyphæ arising from an elevated polycellular, tubercular base; hyphæ clear fuligenous brown, less colored above, 50–135μ long; 5–7μ in diameter at base, and 2$\frac{1}{2}$–5μ in diameter at apex, mostly about 95–130μ long; 5–7μ in diameter at base, and 3$\frac{1}{2}$–4$\frac{1}{2}\mu$ in diameter at apex, above subgeniculate and showing at considerable intervals the old scars where conidia were attached, faintly several septate, not constricted at septa; conidia rather sparse,

hyaline, curved or more rarely straight, clavate or flagellate attached by the truncate base and above attenuate to a subacute point, somewhat faintly multiseptate, not constricted at septa, variable in size, 55–175μ long, 3–4$\frac{1}{2}\mu$ in diameter at base and 1–3μ in diameter at apex, mostly about 90–165μ long; 3–4μ in diameter at base, and 1$\frac{1}{2}$–2μ in diameter at apex. On leaves of *Lobelia syphilitica.* St. George, Pottawatomie County, Kans., September 29, 1888 (No. 1492). The mycelium of this species is rather abundant, hyaline, guttate, about 2–4μ in diameter, but often alternately inflated and contracted, sparingly branched and septate, but near the tubercular bases it becomes many septate, thick, and slightly colored. These bases when young are seen to be composed of the enlarged many-septate bases of the hyphæ, but when fully grown appear as a somewhat irregular mass of rather large cells. A few conidia were seen which had commenced to germinate.

This species is very different from *Cercospora effusa*, (B. & C.) E. & E., which sometimes occurs on the same leaves. It also seems distinct from *Cercospora ochracea*, Sacc. & Malbr., from which it differs, according to the description in Sacc. Syll., Vol. III, p. 447, No. 2151, in the character of the spots, the size of hyphæ and conidia, and color of conidia. Besides, that species occurs on *Lobelia urens* in Europe.

Cercospora euphorbiæ, *n. s.* Spots indefinite, merging gradually into the healthy leaf, dusky or sometimes almost black, but lighter (commonly cinereous dusky) in the center, occupying any portion or sometimes all of the leaf, suborbicular, $\frac{1}{2}$–2^{cm} in diameter, commonly about 1^{cm}; tufts amphigenous but more abundant below, small, scarcely noticeable except in section, rather thickly scattered over the whole discolored area, but more abundant in the central portion, composed of from 3–15 (mostly 5–12) loosely diverging hyphæ which generally arise through stomata, though they have but a very short subepidermal portion; hyphæ dusky or brownish, cylindrical, tapering scarcely if at all, apparently having a round hole in the top, stout, simple, 60–120 by 4–7μ, mostly 75–110 by 5–6μ, sparingly septate, usually not constricted at septa, but sometimes very much so above, often sparingly subgeniculate or dentate from about the middle, usually showing but few marks of attachment of conidia; conidia rather abundant, hyaline, very stout and thick, clavate or cylindrical, straight or slightly curved, attached by the larger blunt end, free and somewhat acute, plainly 8–15-septate, not constricted at septa, usually somewhat granular within, very variable in size, 28–166μ long, 3–6μ in diameter at base and 1–5μ in diameter at apex, mostly 50–120 long, 4–5μ in diameter at base and 3–4μ in diameter at apex. On leaves of *Euphorbia corollata.* St. George, Pottawatomie County, Kans., August 13, 1888. (No. 1494.) This species is rather rare, but is usually abundant on such host plants as are attacked. It does not seem to have much preference for upper or lower leaves, but attacks any. The mycelium is hyaline, sparse, sparingly branched, and septate (?), guttate, rather regular in size, 2–4μ in diameter. The conidia are multiseptate even when small.

Cercospora juglandis, *n. s.* Spots visible on both sides of the leaf, but more prominent above, brown, very small, $\frac{1}{5}$–1^{mm} in diameter, angular, limited by the veinlets and often occupying only a single one of the minute spaces inclosed by the veinlets, often by confluence forming large angular, brown or cinereous brown areas $\frac{1}{2}$–2^{cm} in diameter, in which the original spots may be recognized by their now darker color, usually very numerous, scattered all over the leaf; tufts hypophyllous, prominent, so numerous as to appear confluent over much of the spot except in section, rather large, composed of about 10–30 or more hyphæ which arise through stomata and are densely packed for a short distance below the surface, but are somewhat divergent above; hyphæ slightly dusky, simple, continuous or rarely 1 or 2 septate, scarcely tapering, but often abruptly narrowed, then truncate-rounded at the tip, rather short, the portions above the surface of the leaf being 20–65 by 3–6μ, but mostly 30–45 by $3\frac{1}{2}$–5μ, usually furnished with one or more prominent shoulders near the tip marking the places where conidia were attached, usually nearly straight, but sometimes bent—commonly at the base or near the tip; conidia abundant, evidently dusky, but not quite as deeply colored as the hyphæ, stout, subclavate or cylindrical, narrowed, then rather abruptly truncate at both ends, the basal segment usually somewhat wider than the others, 1–3-septate or rarely continuous, gradually, but evidently narrowed at septa—especially at the middle one, usually strongly curved (often principally at the middle septum), sometimes only slightly curved and rarely straight, variable in length, 33–72μ long, 4–5μ in diameter at basal segment, and 3–5μ in diameter at upper segment, mostly 40–70μ long, $4\frac{1}{2}$–5μ in diameter below, and 3–$4\frac{1}{2}\mu$ in diameter above, wall evident, rather thick ($\frac{1}{2}$–1μ). On lower leaves of medium sized trees of *Juglans nigra.* Manhattan, Kans., August 19, 1887. (No. 1079.) This species is readily distinguished by the color, shape, and thick walls of its conidia. The portions of the hyphæ below the surface of the leaf are very short, straight, and perhaps narrower than the portions above. When septate the hyphæ are narrowed at the septa much as are the conidia. The mycelium is abundant, much branched and septate, and about $2\frac{1}{2}$–4μ in diameter. The species was moderately abundant when found, and had evidently injured many of the leaflets attacked. It is very possible that it might do considerable damage if it attacked very young trees.

Uredo Kansensis, *n. s.* Spots amphigenous but more prominent above; rather sparse, definite or becoming subindefinite; at first greenish yellow with a nearly green center, at length becoming clear brown, very often marginal or running to the margin, subangular; roundish, or, when marginal, subtriangular. Sori hypophyllous or rarely also epiphyllous, very prominent, at first rather small, $\frac{1}{4}$–$\frac{3}{4}^{mm}$ in diameter, but soon by confluence becoming large (1–3^{mm} in diameter), annular, inclosing a small space occupied by spermogonia, appearing of a dull greenish

color, surrounded by numerous, hyaline, clavate, incurved paraphyses, which are about 50–90μ long and 13–20μ in diameter at the top; spores at first obovate or oval, hyaline, when mature oval, subglobose, or sometimes pyriform or elliptical, slightly sordid, in mass appearing of a slightly dirty yellow color, usually slightly and sometimes strongly papillate; 17–35 by 15–22μ, mostly 26–31 by 19–21μ, very easily falling off the pedicels, which are rather obscure, hyaline, closely packed, persistent on the host, forming a dense layer about 30–50 by 3μ; spermogonia amphigenous, occupying the center of the spot, rather numerous, black or dark brown, superficial, depressed, papillate, apparently sterile, 75–100μ in diameter. On leaflets of *Amorpha fruticosa.* Rooks County, Kans. Summer, 1884 (No. 773). June 20, 1888 (Mr. E. Bartholomew, No. 223). Manhattan, Kans., June 21, 1887 (No. 905). June 20, 1889 (No. 1490). Ellis & Everhart, North American Fungi, No. 2255 a (but not b), sub. nom. *Puccinia amorphæ*, Curtis.

This species is very peculiar both in color and in possessing spermogonia. It is very distinct from the uredo stage of *Uropyxis amorphæ*, (Curt.) Schrœt. and appears earlier. The spores seem to originate at the bottom of the layer of pedicels and to be carried up by the growing pedicel. The mycelium is abundant, hyaline, branched and septate 2–3μ in diameter. The cells of the host, which are attacked, usually contain very numerous small (3–5μ) oval, or globose starch grains.

NOTES ON NEW OR RARE FUNGI FROM WESTERN NEW YORK.

By Charles E. Fairman.

The student of mycology in New York turns to the invaluable reports of Prof. C. H. Peck whenever he wishes to ascertain if a given species has been found within the limits of the State. The purpose of this article is to indicate certain species, which have been found in New York, but are not, so far as the author knows, listed in the reports of Professor Peck.

Didymium Fairmani, Sacc., *n. s.* Peridia scattered, sessile, flocose, hyaline, widely reticulate; spores smooth (8–10μ in diameter); thickly studded with crystals; columella subglobose, brownish. On leaves of *Smilacina bifolia.* August, 1886, Lyndonville, Orleans County, N. Y.

Coniosporium Fairmani, Sacc., *n. s.* Differs from the allied *C. apiosporiodes* by its much fewer conidia (5–7μ in diameter), globose, smooth, fulgineous, one nucleate. On cortex of Hubbard squash, exposed to the weather. The fungus covers the surface with black sooty patches. Lyndonville, N. Y., February 10, 1886.

Cytosporina ailanthi, Sacc., and what may be *Phoma ailanthi*, Sacc., occur on *Ailanthus glandulosus*, sparingly, in company with the more common *Camarosporium subfenestratum*, B. & C. *Cytisporium Neesii*, Cda., attacks birches used as ornamental trees.

Diplodia juglandis, Fr., on black walnut, April, 1888.

Diplodia æsculi, Lév.

Diplodia sambucina, Sacc. Rare.

Diplodia maura, C. & E. var. A form of this species has been found on *Pirus Americana*, which Mr. Ellis has designated as var. *Americana.*

Diplodia extensa, Ck. & Hark. in Grev., 1881, p. 83. Occurs on bark of dead maple saplings.

Didymella linderæ, (?) E. & E. On *Lindera benzoin*, April, 1889. Spores fusoid, hyaline, 4 nucleate, 18–20 by 4–5μ.

Didymella ra~~n~~uii, E. & E. Bull. Torr. Bot. Club, X, p. 90. The feature of our specimens is the absence (in those examined) of paraphyses. Sec. Ellis, in Lett. April 16, 1887, "If there are no paraphyses this will be a *Sphærella.*"

Eutypa velutina, (Wallr.) and *Eutypa flavo-virescens*, (Hoff.) Tul. occur rarely on decorticated branches.

Fenestella amorphæ, E. & E., has occurred for two years on small fallen hickory limbs growing while the bark was on the limb (see Journ. Mycol.).

Haplosporella nerii, Sacc., has been found on dead stems of oleander.

Hysterium fraxini, Pers., was found on basswood in good quantity. This is a rare habitat for this species.

Morthiera Thümenii, Ck., var. *sphærocysta*, Peck. This species has been found abundantly on *Cratægus* at North Ridgeway on the County Line Road between Orleans and Niagara Counties, N. Y. The *Cratægus* trees were in use as a hedge, and the fungus bade fair to seriously impair the vitality of the plants, and certainly detracted from the beauty of their foliage. Professor Peck, to whom specimens were referred, says (in lett.) "the cells are nearly globular in your specimens, and I call it variety *sphærocysta.*" *Metasphæria leiostega*, Ell., occurs on rose stems in company with *Didymella ra~~n~~uii.*

Phyllosticta cirsii, Desm., occurs on leaves of Canada Thistle, and *Phyllosticta phomiformis*, Sacc., on oak leaves.

Septoria stellariæ, R. & D., is quite common at Lyndonville on common chickweed about door-yards, and is easily overlooked.

Septoria malvicola, E. & M., is abundant on *Malva rotundifolia* and often checks the growth of that weed.

Septoria divaricata, E. & E., was found on *Phlox divaricata*, Ridgeway, Orleans County, N. Y.

Vermicularia phlogina, Fairman, in Bot. Gaz., March, 1887, attacks the phlox in the same locality, a little later in the season.

Zygodesmus muricatus, E. & E., Bull. Torr. Bot. Club, 1884, p. 17, rarely observed. Color nearer lilac than rose purple.

Agaricus adiposus has been found growing from the base of living apple trees or from roots. Hartig has made the subject of root

parasites a special study (Die Pflanzlichen Wurzelparasiten), and has enumerated many species.

All the species here enumerated were found, when not otherwise indicated, at Lyndonville, N. Y.

NOTES ON THE FUNGI OF HELENA, MONT.

By Rev. F. D. Kelsey.

The following notes are merely a résumé of one year's study of our local fungi; it is necessarily very meager, as my work in botany is done at intervals in a very busy professional career.

The following parasitic fungi have been found by me within a few miles of the city of Helena, Mont., in 1888:

Æcidium abundans, Pk. On *Symphoricarpus occidentalis.*
S. racemosus, var. *pauciflorus.*

Æcidium berberidis, Geml. On *Berberis repens.*

Æcidium chrysopsidis, Ell. & And. On *Chrysopsis villosa.*

Æcidium clematidis, DC. On *Clematis Douglasii.*

Æcidium gaurinum, Pk. On *Gaura coccinea.*

Æcidium glaucis, Dozy & Molkenb. On *Glaux maritima.*

Æcidium hemisphæricum, Pk. On *Lactuca pulchella.*

Æcidium intermixtum, Pk. On *Iva axillaris.*

Æcidium plantaginis, Ces. On *Plantago eriopoda.*

Æcidium porosum, Pk. On *Vicia Americana.*

Æcidium pyrolatum, Schw. On *Pyrola rotundifolia.*

Æcidium ranunculacearum, DC. On *Ranunculus Cymbalaria.*
Anemone multifida.

Æcidium thalactri–flava (DC.) Wint. On *Thalictrum Fendleri.*

Melampsora cerastii, (Pers.) Schrœt. On *Cerastium arvense.*

Uromyces hedsaryi-paniculati, (Schw.) Farlow. I. and III. On *Hedysarum boreale.*

Uromyces spraguæ, (Hark.) I. and III. On *Lewisia rediviva.*

Uromyces trifolii, (Hedw.) Lév. On *Glycyrrhiza lepidota.*

I have in herbarium collected the year previous by F. W. Anderson the following:

Æcidium grossulariæ, DC. On *Ribes floridum.*

Æcidium urticæ, (Schw.). On *Urtica gracilis.*

Coleosporium sonchi-arvensis, (Pers.) Lév. On *Solidago Missouriensis.*

Cronartium asclepiadeum, var. Thesii, Berk. On *Comandra pallida.*

Melampsora epilobii, (Pers.) Winter. II. On *Epilobium coloratum.*

Melampsora lini, (Pers.) Winter. On *Linum Lewisii.*

Melampsora populina, Lév. On *Populus tremuloides.*

Melampsora salicis-capreæ, (Pers.) Wint. On several species of *Salix.*

Phragmidium fragariæ, DC. II. and III. On *Potentilla* sp.

Phragmidium subcorticium, (Schrank.) Winter. I. and III. On *Rosa Sayi* ? or *blanda* ?

Puccinia asteris, Duby. On *Aster commutatus*.
Puccinia cladophila, Pk. On *Stephanomeria runcinata*.
Puccinia flosculosorum, (A. & S.) Wint. On *Balsamorrhiza sagittata*.
III. On *Cnicus undulatus*.
Puccinia fusca, (Rel.) Wint. On *Anemone multifida*.
Puccinia graminis, Pers. On *Distichlis maritima*.
Puccinia grindeliæ, Pk. On *Grindelia squarrosa*.
Puccinia intermixta, Pk. I. and III. On *Iva axillaris*.
Puccinia menthæ, Pers. On *Mentha Canadensis* var. *glabrata*.
I. and III. On *Monarda fistulosa*.
Puccinia mirabilissima, Pk. On *Berberis repens*.
Puccinia phragmitis, (Schw.) Kornike. On *Spartina cynosuroides*.
Puccinia polygoni-amphibii, Pers. On *Polygonum Muhlenbergii*.
Puccinia saxifragæ, Schl. On *Heuchera cylindrica*.
Puccinia tanaceti, DC. II. *Helianthus Californicus* var. *Utahensis*.
Puccinia violæ, DC. II. On *Viola canina* var. *sylvestris*.
Entyloma compositarum, Far. On *Helianthus annuus*.
Ustilago segetum, (Bull.) Wint. On Cult. Oats.
Erysiphe cichoracearum, DC. On *Artemisia Ludoviciana*.
Grindelia squarrosa.
Bigelovia graveolens var. *albicaulis*.
Aster commutatus.
Solidago serotina.
Aster lævis.
Erysiphe communis, (Wallr.) Fr. On *Amelanchier alnifolia*.
Ranunculus Cymbalaria.
Phyllactinia suffulta, (Reb.) Sacc. On *Cornus stolonifera*.
Betula occidentalis.
Podosphæra oxycanthæ, DBy. On *Prunus Virginiana*.
Sphærotheca mors-uvæ, (Schw.) B. & C. On *Ribes floridum*.
Uncinula Salicis, (DC.) Wint. On *Salix flavescens*.
Populus tremuloides.
Dimerosporium populi, E. & E. *Populus tremuloides*.
Cystopus candidus ? (Pers.) Lév. On *Sisymbrium linifolium*.
S. canescens.
Cystopus tragoponis, (Pers.) Schrœt. On *Senecio serra*.
S. aureus var. *croceus*.
Valsa nivea, (Hoffm.) (Spermogonia). On *Populus tremuloides*.
Physalospora megastoma, (Pk.) Sacc. On *Astragalus hypoglottis*.
Sphærella pachyasca (?), Rost. (Fungi Greenland.) On *Phlox Douglasii*.
Leptosphæria artemisiæ, (Fuck.) Auersw. On *Artemisia cana*.
Leptosphæria typharum, (Desm.) Karst. On *Typha latifolia*.
Claviceps purpurea, (Fr.) Tul. On *Elymus condensatus*.
Hypocrea richardsoni, B & M. On *Populus tremuloides*.
Nectria ribis, (Tode) Rabh. On *Ribes* (dead branches).
Dothidea ———: stylosporous stage. On *Helianthus Californicus* var. *Utahensis*.
Dothidea bigeloviæ, E. & E. n. sp. On *Bigelovia* sp.
Actinonema rosæ, Lév. On *Rosa Sayi*, or *blanda*.
Ascochyta colorata, Pk. On *Fragaria vesca*.
Asteroma ribicolum, E. & E. n. sp. On *Ribes floridum*.
Cystospora chrysosperma, Pers. On *Populus tremuloides* (decaying bark).
Phoma mamillariæ, (Web.) On *Opuntia Missouriensis*.

Entomosporium maculatum, Lév. On *Amelanchier alnifolia.*
Botrytis lupini, E. & E. On *Lupinus leucophyllus.*
Didymaria clematidis, Cke. & Hark. *Clematis ligusticifolia.*
Oidium erysiphoides, Fr. On *Echinospermum Redowskii.*
Heterosporium cleomis, E. & E. n. sp. *Cleome integrifolia.*
Rhytisma salicinum, Tr. On *Salix flavescens* var.
Dermatia populina, Schw. On *Populus tremuloides.*

SUPPLEMENTARY NOTES.

By F. W. Anderson.

The foregoing list was kindly sent to me by the Rev. F. D. Kelsey, with the request that I add any names and notes at my command. Having in 1887 spent several months collecting in the vicinity of Helena in company with Mr. Kelsey, and collected in the same neighborhood again in 1888, it is with pleasure I add the following:

Although the combined list is small, it extends the ranges and hosts of some species, besides giving a few new to science.

Æcidium cleomis, Ell. & Anderson. On *Cleome integrifolia.* Appearing chiefly on young plants, affecting the leaves and petioles, and occasionally the stems.

Æcidium compositarum, Mart. Very abundant on *Troximon glaucum*, often destroying leaves of feeble hosts. Same on *Solidago rigida.*

Æcidium lepidii, Tracy & Galloway. On *Lepidium intermedium.* A beautiful scarlet species, the broad, white marginal lobes contrasting strongly with the rich color below. Not very common.

Æcidium monoicum, Pk. On *Sisymbrium linifolium.* One of the earliest to appear. Changes structure of host leaves, causing them to become oval or roundish in outline and much thickened and brittle, margin strongly recurved. Preceded by the remarkably fragrant spermogonia which exude a sticky fluid with a perfume between that of the English Sweet Violet and Hedge Primrose. This fluid is very attractive to beetles, flies, bees, and ants. A destructive fungus having several known hosts and which may in time, perhaps, attack cultivated *Cruciferæ.*

Æcidium urticæ, Schum. On *Urtica gracilis*, was very abundant in Oro Fino Gulch, near Helena, in 1887. It damaged its host considerably.

Phragmidium potentillæ, (Pers.) Wint. On *Potentilla Pennsylvanica* and *P. dissecta* (mountain form). Common and very conspicuous. The rich reddish, orange-colored uredospores are frequently present with the large, black, velvety teleuto-sori, forming a marked contrast.

Puccinia aberrans, Pk. ? On *Sisymbrium linifolium.* Succeeding *Æcidium monoicum* as a rule, but sometimes appearing on the same leaves while the latter is at its best. This is said to differ from the type. I have a typical specimen of this *Puccinia* on the first published host. I also have it varying more or less from the type form on several hosts in other genera from Colorado, Washington Territory, and Utah. No two are alike but all are evidently of one species. The form on *Sisymbrium linifolium* seems to fit in with the rest and if another species it is closely related to *P. aberrans.*

Puccinia caricis, (Schum.) Wint. On *Carex Jamesii* var. *Nebraskensis, Carex filifolia, Carex Douglasii, Carex Pennsylvanica, Carex marcida* and *Carex utriculata.* The other *Carices* of this locality do not seem to be affected by the parasite,

PUCCINIA CLADOPHILA, Pk. On *Stephanomeria minor.* Very abundant at the summit of Mt. Helena. It also occurs on *S. runcinata.*

PUCCINIA RUBIGO-VERA, (DC.) Wint. On *Agropyrum divergens, Elymus condensatus, Kœleria cristata,* and several other grasses.

PUCCINIA FLOSCULOSORUM, (A. & S.) Wint. On *Troximon glaucum.* That this host occurs in Montana is doubted by some, but it certainly does. Rev. F. D. Kesley also has the fungus on this host.

PUCCINIA GALIORUM, Lk. On *Galium boreale.* Rather uncommon.

PUCCINIA GILIÆ, Pk. ? On *Phlox cæspitosa* var. *condensatus.* Common and very destructive to host.

PUCCINIA GRAMINIS, Pers. On *Agropyrum violaceum.* Common.

UROMYCES ERIOGONI, Ell. & Hark. On *Eriogonum umbellatum.* Apparently rare in this vicinity.

UROMYCES JUNCI, (Desm.) Wint. On *Juncus longistylis.* The fungus has been present wherever I have found this host in Montana, but I have not succeeded in finding it upon another host, even of the same genus.

UROMYCES TEREBINTHI, (DC.) Wint. On *Rhus toxicodendron.* Not abundant.

UROCYSTIS COLCHICI, (Schl.) Wint. In the leaf tissue of *Smilacina stellata* growing in shady places.

USTILAGO SEGETUM, (Bull.) Wint. On *Hordeum jubatum.* More common on this host than upon cultivated cereals.

TUBERCULINA PERSICINA, (Ditm.) Sacc. On the cups of *Æcidium porosum* Pk. on *Vicia Americana* var. *linearis.* Common.

TUBERCULINA VINOSA, Sacc. ? On *Lactuca pulchella* with *Æcidium hemisphæricum* Pk. Common.

ERYSIPHE CICHORACEARUM, DC. On *Aster longifolius, A. commutatus Chrysopsis villosa,* and *Cnicus undulatus.* Very common.

ERYSIPHE COMMUNIS, (Wallr.) Fr. On *Vicia Americana,* var. *linearis, Oxytropis Lamberti,* and *Ranunculus repens.* Very scarce here on the *Oxytropis.*

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. On *Typha latifolia.* Rather common on this host in a marsh along Ten-mile Creek near Helena.

SHPÆROTHECA CASTAGNEI, Lév. On *Ribes floridum* in damp woods. Common.

PERONOSPORA GANGLIFORMIS, (Berk.) DBy. On *Lactuca pulchella.* Rather frequent on hosts growing along the borders of the damp woods and thickets.

PERONOSPORA MYOSOTIDIS, DBy. On *Echinospermum Redowskii* Leh. and *Echinospermum floribundum.* Common and extremely injurious to the former host, often killing it; more uncommon on the latter and usually less harmful.

PERONOSPORA PYGMEÆ, Unger. On upper leaves of *Anemone multifida.* I found this only on one occasion, viz. near the summit of Mount Helena, June 8, 1887.

CRYTOSPHÆRIA MILLEPUNCTATA, Grev. On bark of *Populus tremuloides.* Common.

VALSA LEUCOSTOMA, (Pers.) Fr. On bark of *Prunus Virginiana.* Common.

DIDYMOSPHÆRIA EURYASCA, Ell. & Gal. On dead leaves of *Pinus Murrayana,* at the summit of Mount Helena.

PLEOSPORA HERBARUM, (Pers.) Rabh. On dead stems and leaves of *Cymopteris bipinnatus, Actinella acaulis, Aplippapus integrifolius, Oxytropis Monticola,* and many other plants.

PLEOSPORA PERMUNDA, (Cke.) Sacc. On *Clematis ligusticifolia.*

PHLEOSPORA OXYTROPIDIS, Ell. & Gal. On *Oxytropis Lamberti.* Quite destructive to the leaves and flower stalks of host, causing the leaflets to fall away and the flowering peduncles to dry up.

PENIOPHORA OCCIDENTALIS, E. & E. On bark of *Salix amygdaloides* and *Prunus Virginiana.*

SPHÆRIA (DOTHIDEA) LACTUCARUM, Schw. On *Lactuca pulchella.* Common and injurious to the host.

CLAVICEPS PURPUREA, (Fr.) Tul. On *Agropyrum violaceum* and on *A. divergens.*

Plowrightia fruticola, E. & E. On dead stems of *Clematis ligusticifolia.*

Plowrightia morbosa, (Schw.) Sacc. On branches of *Prunus Virginiana.* Common.

Plowrightia symphoricarpi, Ell & Gal. On dead stems of *Symphoricarpus occidentalis.* Common.

Cincinnobolus cesatii, DBy. In the hyphæ and conidia of *Erysiphe cichoracearum* DC. and on *Cnicus undulatus.* I found these specimens near Helena in October of last year. Of all the *Erysiphe* on various hosts I have collected in various parts of Montana this was the only specimen bearing this secondary parasite.

Phoma thermopsidis, Ell. & Gal. On dead stalks of *Thermopsis rhombifolia.* I found this on an old stalk attached to a fine Phænogamic specimen given me by my friend, Kelsey.

Rhinotrichum Curtisii, Berk. On old logs in damp situations, apparently very partial to charred wood.

Zygodesmus obtusus, E. & E. On dead wood of *Populus monilifera.*

Cladosporium graminum, Corda. On *Poa tenuifolia.* Common.

Cladosporium herbarum, (Pers.) Lk. Common on dead or diseased stems and leaves of various plants.

Cladosporium typharum, Desm. On *Typha latifolia.* Common.

Macrosporium iridis, C. & E.? On *Iris Missouriensis.* Common and destructive.

Macrosporium inquinans, C. & E. On dead stems of *Helianthus annuus.*

Crucibulum vulgare, (Tul.). On dead sticks of *Juniperus Virginiana*, also on twigs buried in damp soil. Rather common in moist, shady places on Mt. Helena.

Cyathus vernicosus, (Bull.) DC. On moist ground, Mt. Helena. Fine specimens also grew in Mr. Kelsey's front lawn last summer, where the garden hose was habitually left upon the grass with the water gently flowing.

Phlebia merismoides, Fr. On dead bark of *Populus tremuloides* and *Salix flavescens.*

Trichoderma lignorum, (Tode.) Harz. On dead and decaying trunks of trees.

These names and notes have been culled from my note-book. Neither Mr. Kelsey nor myself have attempted any systematic work with the *Hymenomycetes*, owing to the great amount of time and work necessary for their successful preservation. But we have many edible species here, some kinds of which I have frequently eaten, and it is our hope this year to get together all the Hymenomycetous fungi we can find.

SOME FUNGI OF CUSTER COUNTY, COLO.

By T. D. A. Cockerell.

Mr. Anderson's interesting notes in the last number of the Journal suggest a few remarks on the fungi found here at 8,000 feet and upwards, because we have already all his species. *Claviceps purpurea* occurs with us as high as 8,400 feet, but is rather locally distributed. *Ustilago segetum*, contrary to Mr. Anderson's experience, is quite abundant and injurious to the grain crops, though varying in its destructiveness in different years. The threshing operations must tend greatly to disseminate the spores, which very readily fly into the air to the annoyance of those working round the machine.

We have two species of *Æcidium* that are puzzling, and I do not

know what to call them. One occurs on *Artemisia* and is evidently the same as that found by Mr. Anderson, while the other is found on *Berberis repens*, and is that described by Messrs. Tracy and Galloway in Bot. Gaz., 1888, pp. 126, 127. When I first found them, I called them in my notes *Æcidium artemisiæ* and *Æcidium repentis*, respectively, and I knew what these names referred to. Now, they stand as *Æcidium tanaceti* and *Æcidium mirabilissima*, on the strength of their assumed connection with the *Puccinias* of the same specific names, but I do not feel quite easy about them. In the first place, the *Artemisia Æcidium* may not have anything to do with *P. tanaceti* after all; at any rate, it grew in great abundance just outside the door of my house, and I never saw any of the *Puccinia*. It is much brighter, more orange in color than *Æcidium compositarum*, which grew abundantly on *Aster lævis* at the same place (8,400 feet alt.). Secondly, the *Berberis Æcidium* may or may not be *P. mirabilissima*. It is exceedingly local, and if the *Puccinia* is as local, I may easily have overlooked it, for I never yet saw it, though I have examined any amount of *Berberis*. There is a *Puccinia*, very abundant, that was thought to be a form of *graminis*, and a possible connection with the *Æcidium* was suggested, but it now proves to be *P. caricis*. Another *Æcidium* we have in great abundance is *Æcidium euphorbiæ* on *Euphorbia montana*, and on the same plants occurs *Uromyces scutellatus*, so these may be connected. *Æcidium monoicum* is also abundant early in the year on *Arabis*, distorting the host plant so much that it becomes unrecognizable.

As with Mr. Anderson, *Phragmidium subcorticium* is very abundant on roses, especially *Rosa blanda* and its varieties. *Melampsora salicina* we get on the willows as high up as 10,000 feet.

I am now preparing a list of fungi of this region for the Colorado Biological Association, which becomes possible only through the kind help of Mr. J. B. Ellis, who examines and identifies the species, and assists in every way. Many interesting forms have been met with, all of which will be noticed in due time.

NOTES UPON SPHÆROTHECA PHYTOPTOPHILA, KELL. AND SWINGLE.

By B. D. Halsted.

Some hackberry (*Celtis occidentalis*) trees upon the Agricultural College grounds at Ames, Iowa, are quite badly infested with a mite (Phytoptus) causing prominent distortions of the young branches which frequently form bushy tufts of dwarfed stems that may be seen several rods away, when the trees are not in leaf. While investigating the healthy twigs and those which had been distorted by the mite, to determine the differences in the amount and disposition of the starch and

other reserve materials in mid-winter (January 19, 1889), it was found that the diseased parts were doubly infested. The basal portion of the bud scales were almost coated over with small, nearly spherical, dark bodies which proved to be the perithecia of the new species of powdery mildew, *Sphærotheca phytoptophila*, recently found in Kansas, and described by Professors Kellerman and Swingle in the September issue of the Journal of Mycology, page 93. At this season of the year all traces of the mildew are absent from anything except the infested or abnormal branches, and upon these the perithecia are limited to the bud scales, with a particular preference shown to the lower portion of the scale. Upon further study, the buds infested were found to be much larger than those upon healthy branches and contained the perithecia in all their tissues. For example, a bud well up from the base of a twig might not show any signs of perithecia upon the exterior, but when the large loose scales were removed the bases of the inner ones would expose a dark covering consisting of the mildew perithecia. Longitudinal sections through such buds showed that the living tissue of an ordinary bud was absent, and its space was occupied by an entangled mass of fungous fruit.

It is quite unusual to find a powdery mildew which is so particular as this one in the selection of the place for bearing the perithecia, both as to the character of the branch it selects (an abnormal one) and the part upon it. As fungus parasites thrive upon compounds rich in albuminous substances, and as the *Phytoptus* induces a rapid and therefore comparatively succulent growth upon a tree that normally has a dense wood, firm bark, and minute, closely protected buds, it may however not be so strange that the *Sphærotheca* will flourish upon the distortions caused by the mite when it fails to gain a foothold upon a healthy twig. The extremely favorable conditions offered by the "birds' nests" of soft, green, nourishing tissue, developed through irritation of the mite, probably have vastly more to do with the presence of the fungus than any lack of vital activity or so-called resisting power in the diseased twigs. It is in these parts that the *Celtis* makes much more rapid growth than in the normal parts. It was, moreover, observed that in a cross-section of the stimulated branch there was considerable starch scattered through the bark, while in the healthy and mature twigs, where the buds were normal, smooth-coated, and varnished, there was no starch outside the ring of firm wood. This starch in the bark may be the secret of the success of the *Sphærotheca* upon the infested branches, for the substance under the action of organic ferments yields grape sugar, a most acceptable food for parasitic fungi. If the powdery mildew was a deep feeder like the *Peronosporas* the conditions would be different and the nearness of food supply to the surface of the host of less consequence.

SMUT-FUNGI.

RECENT DISCOVERIES AS TO THE NATURE AND ACTION OF USTILAGINEÆ.*

It is hardly too much to say that the man who clears up the life history of smut-fungi and gives to the world an intelligible account on which a successful treatment can be based, realizes the proud achievement of making two blades of grass grow where only one grew before—a feat worthy of the most devoted consideration of citizens and statesmen, as we have been told on high authority. Perhaps the honor is already due to those botanists—Kühn, R. Wolff, De Bary, and Brefeld—who, following on the earlier and chiefly anatomical investigations of Fries, Persoon, Corda, Meyen, Léveillé, Bonorden, and especially the Tulasnes, gradually demonstrated the biological nature of the *Ustilagineæ*, those subtle fungi which cause the smuts of cereals and onions, etc., the bunt of wheat, and a large number of similar diseases on all kinds of valuable plants.

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For many years previous to about 1840 little was known of these fungi beyond the fact that the bunted or smutted grains of corn were transformed into a dark, powdery mass of minute spores. Somewhat later (I believe first by Bonorden, in 1851) it was found that although, when ripe, there is nothing but spores in the blackened grain of corn, etc., in a somewhat younger condition these spores can be shown to arise from delicate fungous filaments, just as in the case of other fungi. At any rate, this was known to De Bary in 1853, from his own researches on the smuts of maize and other plants, and is now thoroughly established. But although it is now very easy to show the fungous filaments, or mycelium, in the case of some *Ustilagineæ*, they are in others so delicate and so transparent that the most refined methods and practice are necessary to demonstrate their presence. Nevertheless, the dark spores in all cases arise in tufts from the ends of more or less fine filaments. In some cases these filaments have distinct walls and septa, and send suckers (haustoria) into the cells of the tissues; in others they are so minute that it is extremely difficult to say whether they consist of anything more than strands of protoplasm. In some species they are abundant, in others sparse. In many species these fungous filaments can be traced for considerable distances from the diseased spots; in others they are confined to local centers. These characters, as well as other peculiarities respecting the branching, mode of spore formation, gelatinization of the walls, etc., need not occupy us here however, though they are of importance to the mycologist.

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* H. Marshal Ward in Gardener's Chronicle, Vol. V, p. 233.

GROWTH OF THE FUNGUS.

The outcome of all this may be summed up as follows: When the spore is allowed to germinate in water the tough outer skin bursts, and a thin hyaline cellulose membrane inclosing the swelling protoplasmic contents emerges as a delicate tube. In some cases this tube protrudes through a definite thin spot; in others no germination could be induced in water, even though plenty of air was present and the temperature normal. The older the spore the longer the time required before germination.

When the above germinal tube has attained a length of, say five or six times the diameter of the spore, it breaks up into segments, and begins to put out numerous bud-like branches, which soon separate as single cells, looking very like cells of the yeast plant. These yeast-like cells have usually been called sporidia. In some species the sporidia are long and thread-like, and are produced in a sort of coronet. Other varieties in detail occur, but our purpose is served if the reader apprehends that the usual mode of germination in water is for the spore to put forth a short tube (the so-called pro-mycelium), from which several sporidia are then budded off.

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HOW AND WHERE THE FUNGUS ENTERS THE PLANT.

The first steps in the elucidation of the extremely difficult problems here involved were taken by Hoffman, Kühn, and Wolff during the period between 1866 and 1880. Kühn was the first, I believe, to actually perceive the penetration of the fungus into the plant. He showed that if the spores of the bunt fungus (*Tilletia*) are sown with the wheat grains they germinate and produce their promycelia *pari passu* with the emergence of the radicle of the young wheat seedling; from the promycelia are developed the now well known sporidia, and these sporidia then put forth extremely fine fungous filaments, which penetrate the young and delicate tissues of the embryo wheat plant, somewhere in the part (collar) common to root and shoot. Kühn repeated his experiments successfully with the smut of corn, and with several other species, always finding the incipient mycelium of the fungus in the delicate collar. After some years of research Kühn concluded that the normal mode of infection common to the majority of these fungi is the following: The spores ripen in the smutted and bunted cereals with the grain, and are garnered with the latter; they become scattered on the healthy grains, and may be sown in the following spring with these. As the young cereal germinates, the attached spores produce their promycelia and sporidia, and the germ-tubes from the latter penetrate the embryo corn plant. But now came the *crux*. If the fungus is such a virulent parasite as it was made out to be, how is it that we see little or no more of its effects until the late summer and autumn, when the grain begins

to ripen? It is true, refined investigations proved that the mycelium could be discovered in small quantities in the corn plants as they grew larger and older, but it seemed to do no harm; but are we to believe that this mycelium can go on growing in and with the tissues of the corn plant, only to exert their destructive effect months afterwards as the grain begins to ripen?

Astonishing as this may seem it turned out to be the case. R. Wolff in 1873 repeated Kühn's experiments with smuts, etc., and practically confirmed them in every particular; it is true he went a little too far in concluding that only a certain organ (the first leaf sheath) is susceptible to the infection, and Kühn's results were shown to be more accurate in this respect, but the primary fact remains that the sporidia are able to effect an entry into the host-plant by means of their germinal tubes only, provided they attack the embryonic tissues, and especially the cells of these delicate young embryos; once inside, the delicate fungous filaments grow on with the tissues, gradually permeating every part of the plant until, with the development of the young fruit, they meet with the conditions for the fulfillment of their own last purpose—the production of spores. Further investigations only succeeded in demonstrating the correctness, in all essential particulars, of these views.

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DRESSING.

As early as 1781, and even earlier, several observers had satisfied themselves of the infectious character of these diseases, and even in 1820 it had been shown that washing the seed corn with copper-sulphate before it was sown resulted in a diminution of the number of diseased ears; and many interesting experiments were made from time to time tending to prove that (1) if smutted grains are mingled with clean ones, the sowings give an enormously higher percentage of diseased ears; (2) the more the seed-grain is cleaned from adherent spores, the less the percentage of diseased ears; (3) it is only in the early stages of the germination of the grain that the danger of the infection is great.

It was from this foundation that the now well-known process of "dressing" wheat took its origin, and to this may be added some "practical" measures introduced as the outcome of experience, and taught empirically. Let us glance at the results in the light of what is already known. One of the commonest and best-known methods of "dressing" is to steep the grain for some hours in a dilute solution of copper-sulphate in water. The object is to cause so much of the poisonous salt to stick to the coats of the "seed-grain" as will kill the delicate promycelia and sporidia before the latter can penetrate the young corn plant. The chief danger is lest the young seedling should have its delicate tissues injured. Other dressings are used in addition to the above; salts of lime, soda, etc., arsenic, permanganate of potassium, carbolic

acid, and many other substances have been tried and advocated, and various processes for steeping or washing the grain, or for blowing off spores with powerful draught of air, have found more or less favor. In all these cases the result aimed at is to keep the germinating wheat, etc., from contact with the spores, and no one is likely to call in question the wisdom of the intention.

But another question obtrudes itself here, and that is: If the sporidia can really infect the young wheat seedling, etc., only in the stage and at the place described, then should it not be possible to attack the question of protection from another stand-point? In other words, if the fungus can only enter the tender tissues at the collar of the young seedling, then a few hours more or less in the time occupied in the process of germination may make all the difference to the seedling. All these conditions or adaptations which hurry or facilitate the vigorous germination of the seed must lessen the danger of infection, and if it can be shown conclusively that this is the case, an important service to the community has once more been rendered by the biologists. The ground is a little difficult, however, because, unless we are quite sure of our steps, it is somewhat easy to go astray from facts to hypotheses.

MUCRONOPORUS, E. & E.

By J. B. Ellis and Benj. M. Everhart.

The following additional species of *Polyporeæ* have the hymenium spiny:

Mucronoporus *ferruginosus* (Schrad.) issued in N. A. F., 111, as *Polyporus contiguus*, Pers. The N. A. F. specimens were determined by Berkeley some twenty years ago from specimens sent him from Newfield, N. J. Spines abundant, well developed, 30–40 by 5–6μ. Specimens on osage-orange from Missouri (Demetrio, No. 138), and on *Vitis* from Ohio (Morgan, 577), agree in all respects with the Newfield specimens. In Fr. Epicrisis the pores are said to be equal ("æqualibus"). In N. A. F., 111, they vary from round to flattened and subsinuous, and agree in all respects with three specimens of *Poria ferruginosa* (Schrad) from Herb. Berkeley (kindly sent with many other things by Dr. M. C. Cooke). The N. A. F. specimens also agree much better with the description of *P. ferruginosa* than with that of *P. contigua*, and we have very little doubt in referring them to that species.

The specimen of *P. contiguus* in Rav. Fungi Car. I, 16, has the pores equal and round, or nearly so, and judging from specimens in our Herb. from Morgan (74 and 324) are the same as the "*P. unitus*, Pers." in "The Flora of the Miami Valley." The Ohio specimens are on wood of deciduous trees, and the same thing is not uncommon around Newfield on dry dead limbs of oak. Colonel Calkins also sends it from Florida (Nos. 65, 114, 126, 131) on dead limbs of various deciduous trees.

All these we are satisfied are the same, being at first of a yellowish cinnamon color, becoming darker (chestnut) and finally fading more or less, being made up of a thin (1–2^{mm} thick), continuous stratum of subequal, nearly round, pores connected at the base by a thin membrane and with a narrow sub-indefinite margin. The fungus often extends along the limb for 6 inches or more. The inner surface of the pores is constantly clothed with spines, but they are less abundant and mostly shorter (20–30μ) than in N. A. F., 111. There seems good reason to doubt whether this is the *P. unitus* Pers. It certainly does not agree with the figure in Fries Icones which represents it as growing in definite, orbicular, or oblong patches, with a definite margin. *P. unitus* is also said to grow on wood of fir trees and to be 4–5^{mm} thick. We should rather refer the *P. contiguus* of Rav. Car. and the *P. unitus* of the "Flora of the Miami Valley" to *P. floccosus*, Fr., Hym. Eur., 572. The *P. contiguus*, Fr., in deThümen's Mycotheca, 1303, on wood of *Picea vulgaris*, collected in Finland by Karsten, has somewhat the same general appearance, but is softer, has a more distinct margin, and is, as far as we can see, without spines. The Finland specimen certainly agrees better with the *description* of *P. contiguus* than any of the American specimens above mentioned, and is probably the species described by Fries.

Mucronoporus obliquus, (Pers.). An authentic specimen from the herbarium of Fries and one from Dr. P. A. Karsten, Finland, have the hymenium very spiny. Spines at first ovate-conic, 8–12μ, soon elongated 15–30 by 6–8μ, some even 35–40μ long. The specimens in N. A. F. 313 are certainly not this species. The pores are smaller, color inclining more to yellow, and hymenium unarmed or with a very few short spines. There is hardly a doubt that this (N. A. F. 313) is a resupinate form of *Fomes igniarius*, or in some copies (specimens decidedly yellow and spores ferruginous) of *Fomes rimosus*, (Berk.).

Mucronoporus spissus, (Schw.). Specimen from Ohio (Morgan, 298) and from West Chester, Pa. (Everhart), both on hickory. Spines tolerably abundant, 15–25 by 4–5μ. This is a very different thing from the *P. spissus* in Herb. Schw. which appears to be the same as *P. salmoni color*, B. & C. This species (*P. spissus*, Ohio and Pennsylvania specimens) originates beneath the bark, which is soon thrown off directly over it, leaving the surface of the pores lower than that of the bark. The thin, narrow margin is closely attached to the broken margin of the surrounding bark, so as generally to be turned up perpendicularly, but is not properly incurved, though in old specimens after the surrounding bark has fallen away it may have something of that appearance. Whether it is the species described by Schweinitz may perhaps be doubted.

Mucronoporus igniarius, (L.). Finland species from Karsten agree with those in de Thümens Austrian Fungi Nos. 714 and 1007 and Mycotheca Marchica 1504. Spines not abundant, 8–20 by 5–6μ. In poorly developed specimens and resupinate forms of this species the spines are either entirely wanting or very scarce. The specimens in N. A.

F. 915 are doubtful. There appear to be two species mixed, and neither of them in any of the copies now accessible to us are *P. igniarius*. In *some* of the copies certainly this number is *P. rimosus*, Berk., which is yellower and in the young stage of growth has the pileus subtomentose-velutinous, with the hymenium unarmed (as far as we have yet seen) and the spores *ferruginous*.

MUCRONOPORUS NIGRICANS, Fr. Finland specimens from Karsten agree perfectly with specimens collected by Miss Minns on birch trees in New Hampshire. Spines abundant, 12–20 by 5–6μ.

MUCRONOPORUS SALICINUS, (Pers.). Specimens from Karsten Finland. Spines tolerably abundant, 15–25 by 5–6μ. Specimens collected by Miss Minns in the Lake Superior region agree perfectly with the Finland specimens. Both this and the preceding (*M. nigricans*) have the pileus smooth, zoned, and black, but *M. salicinus*, according to the description and specimens, is for the most part resupinate with only a narrow reflexed margin, while in the typical *M. nigricans* the pileus is dimidiate without any effused or resupinate part extending down below it, but in this too there are forms either entirely or partly resupinate.

MUCRONOPORUS CONCHATUS, (Pers.). Specimens from Dr. C. B. Plowright, England. Spines few but stout, 15–25 by 6–8μ. The specimens in N. A. F. 918 have the pores a little smaller, the color inclining more to yellow and the spines rather more abundant. This species has very much the same general appearance as *M. salicinus* but the pileus is *tomentose* and rough.

TRAMETES PROTRACTA, Fr., and FOMES TENUIS, Karst. (specimens from Karsten), also have the hymenium thickly studded with long (30–40μ) spines and will be included in *Mucronoporus*. It may be noted that in all the species enumerated in this and the former paper the color of the hymenium is some shade of rust color or brown. We have not yet noticed any of the light colored species with the hymenium spiny. The same remark will apply to *Hymenochæte*.

NOTES.

By B. T. GALLOWAY.

ASCOSPORES OF THE BLACK-ROT FUNGUS AS AFFECTED BY COVERING WITH EARTH.

As is now well known the ascospores of the fungus causing black-rot of grapes are formed—at least in the majority of cases—during the spring and early summer months in the old berries which were affected the previous season with the disease. On the supposition that burying the old berries in the spring by turning them under with the plow will destroy the spores, many grape-growers go to considerable trouble and expense every year in order that this work may be done effectually. For the purpose of ascertaining just what effect covering berries, which

were known to contain the fungus of black-rot in various stages of growth, would have on the development of the parasite, but more especially to determine how long the fungus could live under such conditions, the following experiment was made by Col. A. W. Pearson, of Vineland, N. J. Old berries which had lain on the ground under the vines all winter were collected on the 10th of May, 1888, and immediately buried in loose garden soil at a depth of about 3 inches. On the 22d of April, 1889, I visited Colonel Pearson and together we uncovered the grapes, finding a goodly number of them apparently as sound as the day they were buried. With an ordinary magnifying glass the pustules of the *Læstadia* were easily made out, but of course a higher power was necessary to determine their contents. Accordingly some of the berries were brought to Washington, and on the 29th of April a number of careful examinations were made of them, but in not a single instance was a spore found.

The conceptacles were as numerous as in fresh specimens, but they were entirely empty. In a few cases some rather loose, broken down mycelium was seen passing through the tissues but it did not seem to be in a growing condition. It appears, therefore, that the fungus does not live for more than one year in the old berries providing the latter are buried beneath a few inches of soil and are subjected to ordinary conditions of weather. It is very probable that most of the ascospores escaped from the buried grapes the first summer, germinated as soon as they came in contact with the moist earth and quickly perished. We have undertaken a series of experiments this year for the purpose of determining, if possible, whether burying the old berries and removing the infected ones as fast as they appear has any material effect in diminishing the amount of rot, and if so, whether it will pay to do this work on a large scale.

THE GRAPE-LEAF BLIGHT.

In the eastern part of the United States, especially along the Atlantic coast south of Pennsylvania, the leaves of both cultivated and wild grape-vines are often attacked and frequently considerably injured by a fungus known as *Cladosporium viticolum.* Professor Scribner has described* and figured this parasite in his "Report on the Fungous Diseases of the Grape-Vine" under the name of the "Grape-leaf Blight," and in speaking of the possibility of its being only a stage of some higher form, says:

"What other spore forms there may be, or how the fungus passes the winter, remains to be discovered."

In May, 1888, we found, under a wild vine (*Vitis æstivalis*) near Washington, which was badly affected the previous summer with the *Cladosporium*, a number of leaves still showing the characteristic spots of the disease. Careful examination of these revealed the interesting

* Bulletin No. 2, Bot. Div.

fact that the fungus had survived the winter and was even then giving rise to immense numbers of spores. The latter did not differ from those formed throughout the summer, excepting that they were somewhat darker. The spores were sown in water and many of them germinated at the expiration of four hours, thus proving their vitality beyond question. Sections of diseased parts revealed the presence of a mycelium not differing to any great extent from that usually seen in growing leaves, excepting that here and there it was knotted together, forming somewhat globular, dark-colored masses, upon which the spores, together with their supporting stalks, were borne. The latter occur in compact bundles, and in our experiments it was shown that it is not uncommon for them to give rise to three or four successive crops of spores. It is very probable that the life of the fungus is in most cases preserved during winter by these bodies, and that the first warm days of spring are sufficient to start them into renewed growth and the consequent formation of spores.

A knowledge of the foregoing facts shows the importance of destroying the old leaves in the fall.

KANSAS FUNGI.

Profs. W. A. Kellerman and W. T. Swingle have just issued their first fascicle of Kansas Fungi, embodying twenty-five species neatly folded in papers, each accompanied by a printed label. The authors propose to issue a fascicle every two or three months, each of which will include about twenty-five specimens, made up of new species or those hitherto undistributed; also species occurring on new host plants. Only a limited number of copies will be issued, and if there are any left after their friends have been provided for they will be sold for $1.25 per fascicle. The following is a list of the species and hosts of Fascicle I:

1. ÆCIDIUM ÆSCULI, E. & K. On *Æsculus arguta.*
2. ÆCIDIUM DICENTRÆ, Trelease. *Dicentra Cucullaria.*
3. CERATOPHORUM UNCINATUM, (Clinton) Sacc. *Carya amara.*
4. CERCOSPORA CUCURBITÆ, E. & E. *Cucurbita perennis.*
5. CERCOSPORA DESMANTHI, E. & K. *Desmanthus brachylobus.*
6. CERCOSPORA LATERITIA, Ell. & Halsted. *Sambucus Canadensis.*
7. CERCOSPORA SEMINALIS, E. & E. *Buchloe dactyloides.*
8. GLŒOSPORIUM APOCRYPTUM, E. & E. *Negundo aceroides.*
9. GLŒOSPORIUM DECIPIENS, E. & E. *Fraxinus viridis.*
10. MELASMIA GLEDITSCHIÆ, E. & E. *Gleditschia triacanthos.*
11. MICROSPHÆRA QUERCINA, (Schw.) Burrill. *Quercus tinctoria.*
12. PERONOSPORA ARTHURI, Farlow. *Œnothera sinuata.*
13. PERONOSPORA CORYDALIS, De Bary. *Corydalis aurea,* var. *occidentalis.*
14. PHRAGMIDIUM SPECIOSUM, Fr. *Rosa Arkansana.*
15. PUCCINIA EMACULATA, Schw. *Panicum capillare.*
16. PUCCINIA SCHEDONNARDI, Kell. & Sw. *Schedonnardus Texanus.*
17. PUCCINIA (LEPTOPUCCINIA) XANTHII, Schw. (*a*) *Ambrosia artemisiæfolia,* (*b*) *Ambrosia psilostachya.*
18. RAMULARIA VIRGAUREÆ, Thuem. *Solidago Canadensis.*
19. ROESTELIA PIRATA, (Schw.) Thaxter. *Pirus coronaria.*

20. SCOLECOTRICHUM MACULICOLA, E. & K. *Phragmites communis.*
21. SEPTORIA ARGOPHYLLA, E. & K. *Psoralea argophylla.*
22. SEPTORIA SPECULARIÆ, B. & C. (*a*) *Specularia perfoliata* (*b*) *Specularia leptocarpa.*
23. SPHÆROTHECA PHYTOPTOPHILA, Kell. & Sw. *Celtis occidentalis.*
24. UREDO QUERCUS, Bordeau. *Quercus macrocarpa.*
25. USTILAGO ZEÆ MAYS, (DC.) Winter. (*Euchlæna luxurians.*)

THE ASH-LEAF RUST (ÆCIDIUM FRAXINI).

This fungus was very abundant in the vicinity of Washington during the summer of 1887, occurring on large and small trees both in and out of the city. Last year (1888) it was comparatively rare, occurring only on small trees in the country, especially those growing along streams or in shady woods. At this time an attempt was made to germinate the spores. They were sown in water, moist air, and several culture fluids, but only in a few cases did they develop germ tubes. As a rule æcdiospores germinate readily when fresh, so that it is difficult to account for the non-success attending our trials. It would be interesting to know whether the spores of this fungus will germinate more readily in seasons when it is abundant.

TREATMENT OF GRAPE MILDEW MADE OBLIGATORY.

According to *Chronique Agricole et Viticole*, published at Lausanne, Switzerland, a decree was issued on May 4, 1889, making the treatment of vines for mildew obligatory. The decree provides that the Department of Agriculture shall give the necessary instructions, and unless these are complied with within the prescribed time the vines will be taken in hand by the authorities and treated at the expense of the owners. The owner for each offense will also be subject to a fine of not less than 10 nor more than 90 francs, this being equivalent to about $2 and $18, respectively.

DIORCHIDIUM TRACYI, DE TONI (PUCCINIA VERTI-SEPTA, TRACY & GALLOWAY).

This interesting fungus was discovered on a specimen of *Salvia ballatæflora* from New Mexico in the herbarium of the Department of Agriculture at Washington, and was described in the Journal of Mycology, Vol. IV, p. 21. As there are, so far as we know, only two meager specimens of this species in existence, we have thought best to illustrate it (Plate X, Figs. 3 and 4), so as to preserve its identity in case anything should happen to the specimens. The genus was established by Kalchbrenner in 1883,* and as it now stands contains five species as follows:

DIORCHIDIUM WOODII, K. & C., on *Melletia caffra* from South Africa.
D. BINNATUM, (B. & C.) De Toni, on unknown host from Nicaragua.
D. TRACYI, (T. & G.) De Toni, on *Salvia ballatæflora* from New Mexico.
D. PALLIDEUM, Winter, on unknown host from Brazil.
D. LEVE, Sacc. & Bizz., on *Manisurus granularis* from Brazil.

*(Grev., XI., p. 26.)

A NEW MODIFICATION OF THE VERMOREL NOZZLE.

In applying the Bordeaux mixture and other copper preparations with the Vermorel nozzle (Fig. 1) it often happens, especially after the pump has been used for some time, that the degorger A when pressed forward for the purpose of clearing an obstruction in the orifice B does not slip back of its own accord, and in consequence the liquid rushes out at C until it is checked by the operator reaching forward and pulling the rod down with his hand. To remedy this difficulty as well as to be able to suddenly stop and start the flow of liquid, which in certain kinds of work is often desirable, we have had constructed the nozzle and lance figured at 2 and 3. It will be seen that the spring C (Fig. 3) and the rod D are practically the same as those in use on the Raveneau nozzle figured and described in Bulletin No. 5 of the Section of Vegetable Pathology* Fig. 2 shows the modified nozzle natural size in section with the orifice G closed by the degorger E. The liquid entering the chamber at F is prevented from escaping at the back of the nozzle by the packing A, through which the degorger E works, and which is tightened by turning the screw of the stuffing box C. The brass spring D should not be fastened to the degorger E for the reason that it is often necessary to remove it so that the degorger may be cleaned and oiled.

Mr. A. L. Holladay, our agent located at Charlottesville, Va., has used the nozzle and lance for some time, and in answer to our inquiries as regards its work, says:

I like the apparatus better than any I have ever used. The spray being readily and quickly cut off, without putting the other hand to the lance, renders it convenient in passing from one row to another, or in passing around the end of a row. Then there is no danger of losing the cup at the end of the degorger and having the liquid squirted back in your face or upon your clothes. Best of all, however, I like the way the degorger springs back of its own accord. With the old nozzle, when the lance is pointed downwards, the degorger often slips forward and then instead of spraying in front the liquid shoots out behind, which is very annoying.

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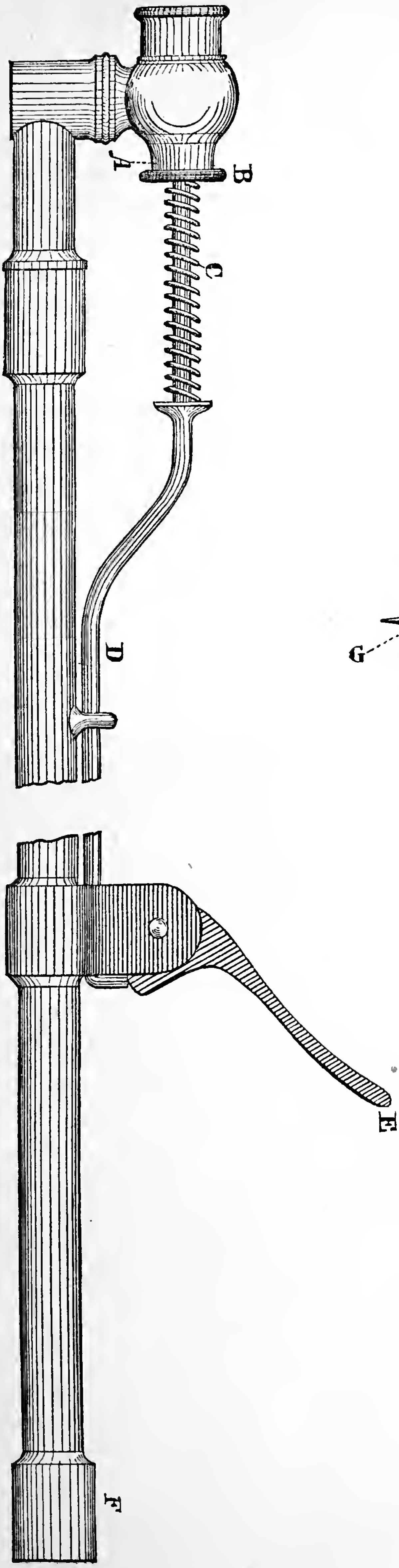
* P. 104.



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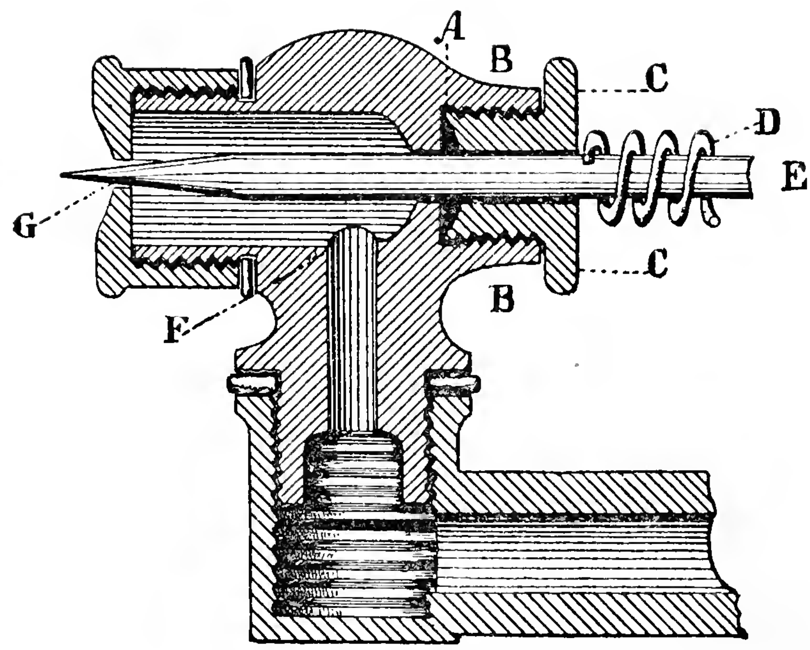

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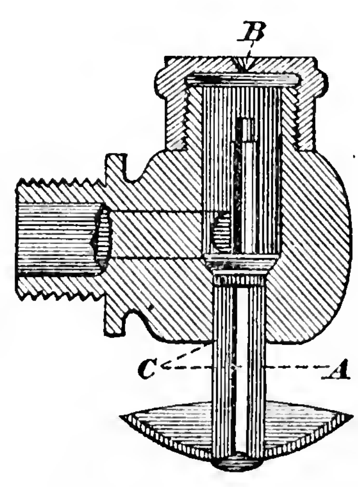


1.

A NEW MODIFICATION OF THE VERMOREL NOZZLE.

REVIEWS OF RECENT LITERATURE.

BREFELD, OSCAR.—*Untersuchungen aus dem Gesammtgebiete der Mykologie. Fortsetzung der Schimmel und Hefenpilze von Oscar Brefeld.* Die Untersuchungen sind ausgeführt im Königl. botanischen Institute in Münster i. W. mit Unterstützung der Herren Dr. G. Istvánffy und Dr. Olav. Johan-Olsen. Quarto. Leipzig, verlag von Arthur Felix. 1888 and 1889. *Heft VII. Basidiomyceten II. Protobasidiomyceten*, pp. 178; 11 lithographic plates. Price 28 marks. *Heft VIII. Basidiomyceten III. Autobasidiomyceten und die Begründung des natürlichen Systemes der Pilze*, pp. 305; 12 lithographic plates.

Space forbids mention of all the interesting and important conclusions reached by Brefeld in these two volumes, which extend and complete Heft III, published in 1877. The work deserves and must everywhere receive the highest praise. A man of less heroic mold would never have undertaken, much less have carried to completion, such a stupendous work. It represents the labor of years, and sums up the critical study of over two hundred distinct species, distributed through about sixty-five genera and subgenera, each of which was grown in sterilized culture media from a single spore. The results of this study, if confirmed by others as in great part they undoubtedly will be, must lead to a number of important changes in classification, one of these being the reduction of the *Uredineæ* to a subordinate position alongside the *Auricularieæ* and *Tremellineæ* under *Protobasidiomycetes*, another being the recognition of the close relationship of the *Ustilagineæ*. Ptychogaster-forms are regarded simply as free-living *Ustilagineæ*, and the smuts must consequently be looked upon as reduced or undeveloped *Basidiomycetes*, destitute of pilei, stipes, etc., and restricted to the production of chlamydospores (smut spores). In like manner the Uredo- Teleuto- and Æcidio-spores of the *Uredineæ* are regarded as only so many forms of chlamydospores strictly comparable with those discovered in *Basidiomycetes*.

Nothing need be said here respecting Brefeld's methods, since they have been already generally approved, and are set forth substantially in Heft IV, only such modifications and improvements of methods there described being employed as time and experience showed to be necessary. It is sufficient to state that single spores were cultivated in suitable media and their growth followed uninterruptedly from germination to the production of fresh spores upon simple or compound sporophores. Many of these were under cultivation for months together, and so thoroughly successful were some of his cultures that by the use of larger and larger slides and by the addition of fresh nutrient material he was able to keep some species under observation

for a space of two years, in fact, until, as in case of *Dacryomyces*, they reached unmanageable dimensions. The following are some of Brefeld's conclusions:

The *Basidiomycetes* separate naturally into two divisions, *Protobasidiomycetes* with divided basidia, and *Autobasidiomycetes* with undivided basidia.

The forms of *Protobasidiomycetes* subdivide into three characteristic families. (See below.) The forms of *Autobasidiomycetes* include the *Hymenomycetes* and *Gasteromycetes* of earlier classifications.

The compound sporophore bearing the basidia is of non-sexual origin and nature.

There is no evidence of sexual reproduction in any stage in any member of this group.

The *Basidiomycetes* have been thought to be destitute or nearly so of pleomorphy. The actual case is quite the contrary. They are as much inclined to pleomorphism as any class of fungi, not excepting *Ascomycetes*.

In *Protobasidiomycetes* conidia are of almost universal occurrence. They are borne either on separate conidiophores, on coremia, or on conidial layers. Even pycnidia occur in *Craterocolla cerasi*. In certain cases conidia may also propagate by budding in yeast form *e. g.* species of Tremella. In *Autobasidiomycetes* conidia also occur, but are somewhat less frequent.

Aside from conidia there are other associate spore forms, the peculiar Chlamydospores. In simplest form they occur as the well-known "oidia," but they also appear in other and higher forms which occur either singly or in masses like sporophores or like conidiophores. These Chlamydospores have not yet been found in *Protobasidiomycetes*, but in most families of *Autobasidiomycetes* are very widespread in Oidium form, less common under more highly developed forms. In some instances entire mycelia assumed the Oidium form and propagated repeatedly like "*Oidium lactis*," nor could the author induce them to assume any other form by artificial cultures in nutrient solutions. In the genera *Nyctalis*, *Fistulina*, and *Oligoporus* (Ptychogaster) highly developed chlamydospores are particularly abundant.

The discovery of these associate spore forms gives a peculiar character to this whole class of fungi and is extremely important in a morphological sense, not only for the arrangement of the several portions of the class, but also as determining its relations to other classes. Heretofore the basidia and basidiospores were of small value morphologically. They could not be compared with any other spore form. The conidia are the most essential for comparison. The chlamydospores are non-sexual intercalary forms. For the explanation and understanding of the basidia and *Basidiomycetes* they are of no importance.

The basidia are also conidiophores, but with this distinction, they

have become specialized and stand on a higher level morphologically; or, as Brefeld puts it:

The conidiophore as a basidium has become typical and regular in form and segmentation and especially in number of spores; *the conidiophore, in the narrower meaning of the word* stands upon a lower level; it has not yet reached this typical regularity of form and in connection therewith the definite number of spores; in both it oscillates continually and, influenced by suitable conditions, is large or small, is thickly covered on its top with spores, or poor in spores, or reduced sometimes even to a single spore.

From this and following statements it is clear that Brefeld considers the compound sporophores of *Hymenomycetous* and *Gastromycetous* fungi as evolutions from earlier and simpler conidial forms, many of which still persist. The impossibility of deriving all these forms from one primitive stock is so apparent that he writes with a grim delight:

Wo bleibt nun hier die Systematik de Barys, etc.

and again more severely:

Diese Systematik hat höchstens noch den Anspruch, als ein Beispiel fort zu bestehen, welches lehrt, wohin blosse Deductionen in der Systematik führen, wenn sie nicht auf dem Boden der vergleichende Morphologie stehen.

The reader will be interested in comparing Brefeld's scheme of classification here reproduced with that given by De Bary in his *Morphology and Biology*, English ed., p. 132, German ed., p. 142:

Natural system of the filamentous fungi.

- Phycomycetes (lower, algæ-like, sexual fungi).
  - I. Class *Zygomycetes*. Sexual reproduction by Zygospores.
    - Non-sexual propagation.
      - By sporangia only. (*) — Mucorini. Thamnidiæ (†).
      - By sporangia and conidia. (**) — Choanephoreæ (†).
      - By conidia only. (††) — Chætocladiaceæ (†). Piptocephalideæ.
  - II. Class *Oömycetes*. Sexual reproduction by oöspores.
    - Non-sexual propagation.
      - By sporangia or conidia. — Peronosporeæ. Saprolegniæ. Chytridiaceæ.
      - By conidia only. — Entomophthoreæ.
- Mycomycetes (higher, non-sexual fungi).
  - Ustilagineæ. Intermediate forms.
    - Propagation.
      - By sporangia (*) resembling asci. — Protomyces (provisionally one genus only.)
      - By conidia resembling basidia. (††) — Ustilago, Tilletia Sorosporium, etc. (the remaining forms of the smut fungi).
  - I. Class *Ascomycetes*. Propagation by sporangia and conidia. (**) Sporangia in asci.
    - Exoasci (asci naked). — Exoascus, Taphrina (provisionally only these two genera).
    - Carpoasci (asci in compound fruit-bodies). — Tuberaceæ. Pyrenomycetes. Discomycetes (the characteristic mass of Ascomycetes) with their subfamilies.
  - II. Class *Basidiomycetes*. Propagation by conidia only. (††) Conidia borne on basidia.
    - Protobasidiomycetes. (Basidia divided).
      - Gymnocarpous. (‡) — Uredineæ. Auriculariæ. Tremellineæ.
      - Angiocarpous. (¶) — Pilacreæ.
    - Autobasidiomycetes. (Basidia undivided.)
      - Angiocarpous. (¶) — Lycoperdiaceæ. Nidularieæ. Phalloideæ. Hymenogastreæ.
      - Hemiangiocarpous. — Thelephoreæ. Hydneæ. Polyporeæ. Agaricini.
      - Gymnocarpous. (‡) — Dacryomycetes. Clavarieæ. Tomentelleæ.

The asterisks, etc., denote genetic kinships, indicated in Brefeld's table by connecting lines.

The general observations of Heft VIII are completed by two very interesting chapters on (1) *The Morphological Value of Chlamydospores in Fungi* and on (2) *The Morphological Value of Conidia in Fungi.* There is also a sort of appendix on *The importance of light for the development of certain fungous forms.* The conclusion of the latter is that, in the fungi which were examined (*Pilobolus*, *Coprinus*), light has no influence, on sterile mycelial growths, but that it is absolutely essential to the

normal development of the primordia and the compound sporophores, the blue-violet end of the spectrum being the only stimulating portion. In many cases the mycelia remained absolutely sterile when kept in darkness or when exposed only to yellow light.

In his preface to Heft VII the indefatigable author promises to return to the smuts in Heft IX and to the *Ascomycetes* in X and the following Heften. We trust he may be spared life and daylight to the completion of his great task, the material for which he tells us is already in good part accumulated and only remains to be put into proper shape.—ERWIN F. SMITH.

MIYABE, KINGO. *On the life history of Macrosporium parasiticum*, Thüm. Annals of Botany, February, 1889.

The investigations, the results of which are set forth in this paper, were carried on at Harvard University under the direction of Dr. Farlow, the material for study, consisting of onion plants, having been sent to him from Bermuda. Without going into the details of the work it may be said that Mr. Miyabe concludes that *Macrosporium parasiticum*, Thüm., is the same as *Macrosporium sarcinula*, Berkeley, and that both of these so-called species are merely forms of the common *Pleospora herbarum*. He further shows that there are only two forms of the *Pleospora*, *i. e.*, the *ascosporous* and the *Macrosporium*, and remarks in his recapitulation that the presence of pycnidia is very doubtful, and may have disappeared from the fungus cycle of development altogether. It is shown that the formation of the perithecia is not attended by any sexual act, and finally that the *Macrosporium*, contrary to the usual belief, is a true parasite, having power of developing within the tissues of plants not previously injured by fungi or other causes.—B. T. GALLOWAY.

LAGERHEIM, G. *Ueber einige neue oder bemerkenswerthe Uredineen.* Hedwigia Band XXVIII, Heft 2, p. 103.

In this paper are given the results of some recent observations on several genera of *Uredineæ*, the first of which is *Diorchidium*. This genus, according to the author, was established by Kalchbrenner in 1883 from specimens occurring on *Milletia caffra*, collected at Port Natal, South Africa. It differs from *Puccinia* in having teleutospores divided by perpendicular or oblique instead of horizontal cross-walls. Soon after the attention of mycologists was directed to this peculiar genus, new species were found, the first among these being *Diorchidium læve*, Sacc. & Bizz., on *Manisurus granulis* from Brazil, and *Diorchidium pallidum*, Winter, on an undetermined host plant from the same place. Later, De Toni in Sylloge VII, p. 736, referred *Triphragmidium binatum*, Berkeley, on an undetermined host plant from Nicaragua, and *Puccinia verti-septa*, Tracy & Galloway, on *Salvia ballatæflora*, from New Mexico, to the same genus. In the case of *D. pallidum* and *D. verti-septa* uredo-

spores were described as occurring with the teleuto form, but of the remaining three species only the latter stage was observed. In one of these, *D. læve*, S. & B., on *Manisurus granulis*, the author has recently discovered the uredo form, which he describes as occurring abundantly on both sides of the leaves. The sori are scattered and give to the surrounding parts a reddish or yellowish hue. The spores are roundish or ovate, 24–30μ in diameter, and are more or less spiny. Teleutospores of this species were very scarce. They are roundish or ovate, greatly enlarged at the apex and often somewhat concave. The author concludes his remarks on this genus by saying that it is certainly closely related to *Puccinia*, the only difference, so far known, being the position of the septum, which is never constant.

Following the foregoing observations are notes on a new variety of *Puccinia Schneideri*, Schrœt.; *Puccinia rubefaciens*, Johans.; *Puccinia silphii*, Schw.; *Puccinia Scymeriæ*, Burr.; *Puccinia ribis*, D. C.; *Puccinia oxyriæ*, Fckl.; *Uromyces Holwai, n. s.; Uredo arcticus, n. s.*, and *Cæoma nitens*, Schw.

Uromyces Holwai was collected at Ann Arbor, Mich., by Mr. E. W. D. Holway on *Lilium superbum*. Both the uredospores and teleutospores occur at the same time, appearing on both sides of the leaf. The Æcidium was not found. The uredospores are roundish, spiny, and are 20–26μ in diameter. The teleutospores resemble in every respect those of *U. erythronii*, (DC.), excepting that they are of a somewhat lighter color and have a thicker apex. In speaking of *Cæoma nitens* the author cites the opinion of several writers as to the probable connection of this fungus with other *Uredineæ* occurring upon *Rubus*, concluding his remarks by a reference to Allescher's paper, published in Bot. Centrablatt, No. 48, 1888, in which it is shown that the *Cæoma* is an isolated form.—B. T. GALLOWAY.

PLOWRIGHT, CHARLES R. *A Monograph of the British Uredineæ and Ustilagineæ.*

The appearance of this book was gladly welcomed by American botanists, although it does not deal with distinctively American species. It fills a need long felt by workers in this special field by combining in a convenient form the history, biology, morphology, classification, and economics of the rusts and smuts. The economic features are not directly treated in detail, but every portion abounds in notes and suggestions that can be applied to this phase of the subject, and the chapter on infection bears directly upon it.

The first part of the book comprises chapters on the biology, mycelium, spermogonia, æcidiospores, uredospores, teleutospores, and heterœcism of the *Uredineæ;* on the mycelium, formation of the teleutospores, and germination of the teleutospores of the *Ustilagineæ;* on infection of host plants by the *Ustilagineæ;* spore culture, and artificial infection of plants.

The object of the book, the author says, "is to obtain an insight into the life history and structure of the species of parasitic cryptogams occurring in Great Britain."

In the chapter on spermogonia considerable attention is paid to the attractions offered to insects by the saccharine qualities and odor of the spermogonia themselves and the bright color of the spots on which they are produced. A large number of experiments on the germination of spermatia were made, and the author succeeded in germinating the spermatia of the æcidia on *Bellis perennis*, *Ranunculus bulbosus*, *R. ficaria*, *Anemone coronaria*, *Lapsana communis*, and some others, but he did not succeed in infecting healthy plants. He discovered important differences between the budding spermatia and true yeast spores, in that the former did not produce alcohol. The function of the spermatia is discussed at some length, and the author concludes that the balance of evidence points to the conclusion that the spermatia are not sexual organs, but may possibly be conidia.

An important item in the chapter on æcidiospores is the fact that Plowright could not induce them to germinate after forty-eight hours, contrary to De Bary, who states that they retain their germinative faculty for some weeks.

Under Uredospores he notes the production of sporidia when the germ tube can not enter a stoma, and discusses the significance of paraphyses occurring with the uredospores. He considers them as morphologically analogous to the pseudo peridial cells of the æcidiospores, and says that when uredospores do not arise directly from the æcidiospores they are constantly present, but hardly present at all when the uredospores arise directly from the æcidiospores. He thinks that this indicates that they are an indication of exhaustion of vital energy, which is combated by protective efforts on the part of the fungus in preserving the spores it does produce.

Considerable space is devoted to the influence of barberry bushes on wheat and to the development of the knowledge of the heterœcism of the *Uredineæ*. The latest results on the subject are given in a tabular statement which may be summed up as follows: Forty-seven teleutospore forms have been connected with their corresponding æcidia. Of these Plowright himself has established the connection in eleven cases and verified it in twenty-seven others.

The *Ustilagineæ* are dealt with in essentially the same manner as the *Uredineæ*. After a short chapter on the mycelium, the author devotes a much longer one to spore formation, which he describes in detail for each genus. The chapter on germination includes descriptions of germination in all the different genera, together with fifteen species of *Ustilago*, five of *Urocystis* and three of *Entyloma*.

The chapter on Infection of Host Plants by the *Ustilagineæ* is devoted to discussing as to when and where the germ tubes of *Tilletia tritici* and *Ustilago segetum* enter the young plant; while this has been practically

settled for the former, Plowright's experiments with the latter have only brought forth negative results. The chapter has a very practical application in that the decision of the question decides the best method to be followed in dressing seed to prevent smut. The fact that the question has been decided in case of bunt has enabled farmers to practically avoid it by a little exertion.

The chapters on spores culture and artificial infection of plants had perhaps been anticipated as eagerly as any by practical workers, and, while we could wish they had been longer, they are full of valuable suggestions.

The descriptions of species are full and accompanied by lists of synonyms, exsiccati, dates of appearance and disappearance, and biological notes. Plowright follows Winter in his method of citing authority. Where there is a double citation he retains the original authority in parentheses and omits the other. He has also followed Winter's classification, but has introduced the *Brachyuromyces* and *Brachypuccinia* to cover those forms having spermogonia, uredospores, and teleutospores. There are no *Uromyces* corresponding to this division, but the following *Puccinias* are included under it: *Puccinia suaveolens*, *P. bullata*, *P. hieracii*, *P. centaureæ*, and *P. taraxaci.* Winter places the first two under Hemipuccinia and includes *hieracii* and *taraxaci* under *P. flosculosorum*, one of the Antepuccinias.

In *Phragmidium* Plowright omits any subdivisions, but in *Melampsora* he departs entirely from Winter's arrangement and gives the following:

I. *Melampsora.* Teleutospores formed outside the epidermal cells of the host plant, and remaining single.

II. *Pucciniastrum.* Otth. Teleutospores formed outside the epidermal cells, becoming longitudinally or obliquely divided into from two to four cells.

III. *Thecopsora.* Magnus. Teleutospores formed in the epidermal cells, becoming confluent into irregular circumscribed masses. Uredospores in pustular heaps.

IV. *Melampsorella.* Schrœt. Teleutospores undivided, formed inside the epidermal cells (intracellular), hyaline, confluent in wide-spreading masses. Promycelial spores hyaline. Uredospores echinulate, inclosed in a pseudoperidium.

Coleosporium and *Chrysomyxa* are subdivided in the same manner as *Uromyces.*

There is a supplement containing a description of species of the related genera, *Graphiola*, *Entorrhiza*, *Tuberculina*, and *Protomyces.*

The book also contains a copy of the Massachusetts barberry law and a glossary, and is well indexed—E. A. SOUTHWORTH.

PRILLIEUX, M. *Maladie des Feuilles des Pommiers et Châtaigniers en* 1888. Society Mycologique de France, Tome IV, p. 143.

In this paper the author gives an account of two very destructive diseases which prevailed among apple and chestnut trees in several parts of France in 1888. The diseases are caused by parasitic fungi, and in case of the apple the fungus makes its appearance about the last of August and develops rapidly during the month of September. The disease is first manifested by a shriveling of the leaves, which quickly turn brown and fall, leaving the limbs entirely bare long before the proper time. Careful examination of the affected parts reveals the presence of the body or mycelium of the fungus growing in the tissue, and further manipulations show that at certain points just beneath the epidermis it is massed together, forming dark-colored sclerotia-like bodies. From these arise the conidiophores, which bear upon their tips the spores or reproductive bodies; these are usually oblong, occasionally one-celled, but more often divided by one or more transverse partitions. The mycelial filiaments also occur abundantly on the surface, forming numerous little dark-colored bodies similar to those produced beneath the epidermis. M. Prillieux places the fungus in the genus *Cladosporium* and states that it is closely related to *Cladosporium herbarum* var. *fasiculare.*

Besides the *Cladosporium* there is also produced on the same spots conceptacles of two sizes and kinds, the smaller ones being a *Phoma*, the larger certainly the perithecia of a sphæriaceous fungus having the asci only partially developed. Nothing is said in regard to the probable connection of the foregoing forms, but in concluding his paper the author remarks that leaves containing the perithecia have been placed where the future development of the fungus can be studied.

In speaking of the chestnut disease the author says that the fungus attacks the leaves, frequently injuring them to such an extent that none of the fruit matures. The leaves, when first attacked, show here and there on the surface little brown dots, which soon run together, forming larger blotches. Ultimately the leaves fall to the ground and perish. The withered spots are covered on the under side with the black conceptacles of the fungus, and in these the reproductive bodies are formed. The fungus appears to be the same as that described in Saccardo's Sylloge, Vol. III, p. 35, under the name *Phyllosticta maculiformis*, Sacc. This fungus is believed to be a form of *Sphærella maculiformis,* but so far as known their relationship has not been proved. The author closes his remarks by saying that the great damage to the chestnuts by the parasite the past season is probably owing to the exceptional humidity of the atmosphere throughout the entire summer. He further states that the only means of controlling the disease which a knowledge of the facts in the case suggests is to gather the leaves in the fall and burn them.—B. T. GALLOWAY.

THÜMEN, FELIX VON. *Die Bekämpfung der Pilzkrankheiten unserer Culturgewächse.* Versuch einer Pflanzentherapie zum praktischen Gebrauche für Land- und- Forstwirthe, Gärtner, Obst- und Weinzüchter. Verlag von Georg Paul Faesy, Wien, 1886, paper, 8vo., pp. 157.

This modest little volume is a move in the right direction, and deserves more attention than it appears to have received in this country.

In a brief and interesting manner, albeit not in very choice German, the author describes some of the more destructive fungous diseases of orchard, garden, field, and forest, and states concisely the best methods of dealing with this class of diseases. In reading, however, one is especially struck by the advance which has been made in the treatment of the vine mildew, *Peronospora*, since 1885, when the author wrote: "A favorable result is not to be expected from any fungicide; up to this time at least all proposed remedies have proved totally inadequate, or at least impracticable on a large scale."

Thirty-five distinct diseases are included, distributed as follows: 13 on field crops, 10 on fruit and garden vegetables, 6 on the vine, and 6 on forest trees.

In the introduction, which to the general reader is, perhaps, the most interesting portion, Professor von Thümen discusses those special conditions which, in his judgment, favor the increase of this class of diseases. They are:

(1) The accidental introduction of foreign parasites (*Einschleppung*).

(2) The almost universal neglect of field hygiene, meaning by this the destruction of neighboring wild plants, etc., which might harbor injurious fungi.

(3) The growth of one crop repeatedly (*Hypercultur*) whereby every opportunity is given for the excessive multiplication of parasites.

(4) Propagation by unnatural methods, *i. e.*, by layering, budding, grafting, etc.

(5) The ever-increasing business intercourse and movement of population.

It is apparent from these statements that the author believes the control of this class of diseases lies largely in the hands of the cultivator. He should guard against foreign enemies; he should carefully destroy weeds, etc., likely to harbor parasitic fungi; he should practice rotation of crops; he should return as much as possible to varieties raised from seed, and, finally, he should keep a sharp watch lest enemies be introduced from neighboring localities in unsuspected ways, *e. g.*, with goods, seeds, grains, vines, etc.

His remarks on "the root-mould of the grape-vine" appear of sufficient interest to be reproduced in full, especially in view of the possibility that the mysterious and destructive vine disease of California may be due to some similar parasite.

"Within a few years—about six or eight—numerous complaints have

come from the vine districts of the most different lands about a so-called mysterious disease to which single vines or larger parts of the vineyard have fallen victim. Without visible cause stocks here and there in vineyards which have stood for decades or centuries in good cultivation and sound growth begin to be sickly, their leaves become yellowish, then withered and drooping, their ends and edges growing brown; end shoots and other young shoots dry up, and, in many cases, the whole aspect gives exactly the impression that the vineyard has been attacked by the vine-louse. At other times there occurs in the vine generally only an extremely slight vegetative activity, as one may readily observe if he passes through the vineyard in May or in the early part of June. Then we notice that the stocks attacked by the "mysterious" disease have developed only a very few short shoots, and these bear scanty, small leaves, and a few short abnormal-looking small clusters. Finally, we also meet vines with foliage of a peculiar green, difficult to describe, and on which a marked shortening of the internodes is especially striking, giving to the affected stock a bushy appearance which, in connection with a not very considerable but yet clearly visible crinkling (*krauselung*) of the leaves, has given to the affected stocks (in lower Austria) the common name ("*Kraupet*") frizzles (?).

A scrupulous examination of the roots shows that no vine-louse is at the bottom of this trouble; moreover no other insect, at least no abundantly appearing parasite, is present to which one might, perhaps, ascribe the sickening of the plants. Just as little can we find on the withering or dead leaves or shoots any fungous growth whose action has caused the sickening of the vine. It therefore happens in very numerous instances that the experts, practical or theoretical, who have been drawn thither stand helpless in face of the disease. It may be accepted as certain, moreover, that this disease is in no sense a new one, but that it has existed for a long time, although it probably formerly appeared much more rarely, and in consequence was overlooked and not considered. For a long time this described appearance has been known to vine-growers in France and Switzerland, and given them much concern. There, also, they got pretty well on the track of the symptoms of the disease, although many of the views, assertions, and explanations there published lack all permanency and scientific basis.

There is no doubt that the sole and only seat of the disease is to be looked for in the roots of the vine, and therein exactly, as well as in its extraordinary invisibility, is to be found the reason why the peculiar cause of the malady remained so long unknown. A fungus extremely invisible and easily overlooked, or more strictly a sterile fungous growth, is the cause of the sickness and death of the vine. If we examine minutely the roots of those vines which show some of the symptoms described in the beginning, we shall observe first of all a strikingly small number of fibrous and dependent roots, often, indeed, their entire absence; and further, we shall see on those still present, as well as on the

larger main roots, very delicate, fine, almost cob-web-like, white, fungous threads, which are abundant or scanty, conspicuous or with difficulty demonstrable, and which cover and overgrow the organ in many places, and sometimes even spin all around it. The great fragility and tenderness of these growths is, however, also the reason that they are so easily torn off and destroyed in pulling the vines out of the earth. On this account, for the more certain demonstration of the trouble, it is requisite that the removal of the vines be effected with special care and exactness. This fungus does not possess any organs of fructification, but consists entirely of very thin, hyaline, cylindric-tubular threads or hyphæ, septate at long intervals. It is nothing but a so-called sterile mycelium. Although the scientific identification and naming of such sterile forms is beset with great difficulty, still, without special violence, we can identify the root-mould of the vine with the growth *Fibrillaria xylotricha*, described by Persoon.

Similar sterile mycelia, which, in essential particulars, at least, do not depart from those on the roots of the vine, are found everywhere on decaying twigs and branches of deciduous and coniferous trees, as well as on all sorts of decaying wood lying below the earth's surface; finally also on the roots of very different plants, in short, wherever woody parts begin to decay. If, for example, in a shady forest we examine a heap of broken-off, withered branches or a pile of limb-wood, we very soon observe, as we throw it somewhat apart, that the whole mass is penetrated in all directions, in case it has remained undisturbed some weeks, by fine, hyaline, thin and delicate threads. Almost every single small branch is woven and spun over; and the moister the locality the more restricted the access of air, so much the more compact is the weft, so much the more numerous are the threads.

But this observation here communicated puts us at once on the right track; it shows us a parasite injurious to vine growing, but on the other hand gives us the method by which we can protect our plantations from its attacks. In like manner, as into the small branches and twigs, the encircling, thin, fungous threads penetrate into the roots of the vine, the tissues of which they disintegrate, first those of the outer bark, then, later, pushing steadily inward, they ramify between the wood cells, brown these first, and then bring them quickly to destruction, and thereby progressively the whole organ into decay. It is evident that the thinner and weaker roots first suffer the attacks of the invisible, but not on this account less dangerous, enemy, and this is why, as already emphasized, we find the diseased vine when lifted out of the ground almost wholly denuded of horizontal (*thau*) and fibrous roots, and entirely dependent upon the main roots for nourishment. For this reason, the sickening and decay of the plants, the main roots alone not being able to perform the function of sustenance.

If the subsoil of the vineyard is unduly impervious while the surface soil is very loamy and clayey, then the excessive wet, so hindered from

running off or settling down, causes easily of itself, as it stagnates, a growth of fungous mycelia, and the roots of the vine have accordingly to suffer from it in the way described. For overcoming such conditions we shall have to bring into use various methods adapted in each case to the local conditions, *e. g.*: drainage, thorough loosening and aerating of the soil, earth mixture by carting on sand, contingently also the addition of gypsum.

But in the greater number of cases man himself is the guilty party—the keeping clean of the soil being only too often grossly neglected. Upon the surface, indeed, the industrious and methodical vineyardist does not fall into error so easily, since several times a year the entire vineyard will be cut over (*behauen*) and carefully weeded by hand or by the plow. But this alone does not long suffice; the deeper portions of the soil must also be carefully cleaned, and this unfortunately is almost everywhere slighted, probably entirely neglected. If the branches and twigs lying in the open air form a most favorable soil for those tender, white, fungous threads, how much more must the same objects further their growth when buried deep in the earth where the air supply is so much more scanty. All wood fragments occurring in the soil figure as the most important spawn ground of such mycelia—and such fragments are never absent from the vineyard.

In the removal of old or dead vines, in intrenching (*vergruben*), etc., numerous root fragments always remain in the earth; in grubbing and hoeing (*behauen* and *hacken*) such are easily cut off; in pulling out vine palings in autumn numerous pointed ends are broken off and remain in the soil; enough wood fragments are accidentally introduced into the vineyard with the stable manure; dead twigs fall from the fruit trees frequently planted in the vineyard, or prunings occasionally remain; or pieces of roots are easily cut off in working the soil; or wood may be introduced in various other accidental ways. But we also bring many sorts of wood into the vineyard directly, especially where the objectionable custom prevails of burying deciduous and coniferous brushwood for the loosening and improvement of the soil. The described mycelia develop most luxuriantly upon all these various wood fragments—indeed, frequently enough such fragments are entirely covered with the mycelia, even before the wood is buried, and their migration to the roots of the vine and the infection of the latter is only a question of time.

But the causes of the root mould here described give at the same time a correct indication for the satisfactory treatment and banishment of this destructive disease. We have already spoken of a gradual improvement of the soil and drainage, but in addition the most punctilious preservation of the vineyard soil from all wood is the most certain means of protecting it from the root-mould. Again, it must be insisted on strongly that in pruning the vines the workman shall carefully gather and remove all the separated shoots, so that nothing whatever

shall remain lying about in the vineyard. Likewise in hewing must all resulting wood fragments be scrupulously gathered and immediately removed. All stocks once attacked by the disease must be pulled out and burned as soon as possible—all still existing roots, with the very utmost speed. Finally, moreover, care must be taken in the removal of vine stakes at the beginning of the winter that the points, sometimes broken off in this way, are not left in the ground. Were it in general practicable, from local or pecuniary reasons, to remove the vine palings entirely and substitute cultivation upon wires, then certainly one chief source of infection would be entirely removed. In conclusion, it may also be mentioned that where persons do not feel able to do without forest litter in the cattle stables and the use of the resulting manure in the vineyard, a frequent scattering of Stassfurt fertilizer or kainit in the stables and on the dung pile will result in good, as thereby, the beginning of this fungous mycelia will be hindered."

Three other underground parasites are considered—*Phasmodiophora*, *Dermatophthora necatrix*, and *Rosellina quercina;* but no mention is made of *Agaricus melleus* or of Hartig's *Trametes radiciperda*, which Brefeld now says (VII, p. 14) should unquestionably be referred to *Polyporus annosus*, Fr.—ERWIN F. SMITH.

DESCRIPTION OF PLATES.

PLATE IX (after von Tavel).

Glœsporium nervisequum.

FIG. 1. Cross-section through a vein and pustule of the fungus; the basidia are only partially drawn. The abscision of spores has not yet begun. x 380.

2. Spores. x 380.

Fenestella platani.

3. Cross-section through a young stage. The representation of the host plant is diagrammatic. x 128.

4. More advanced stage. x 128.

5. Same mature. The spore mass is only indicated. x 80.

PLATE X.

FIG. 1. *Langloisula spinosa* mycelium. E. A. Southworth, del.

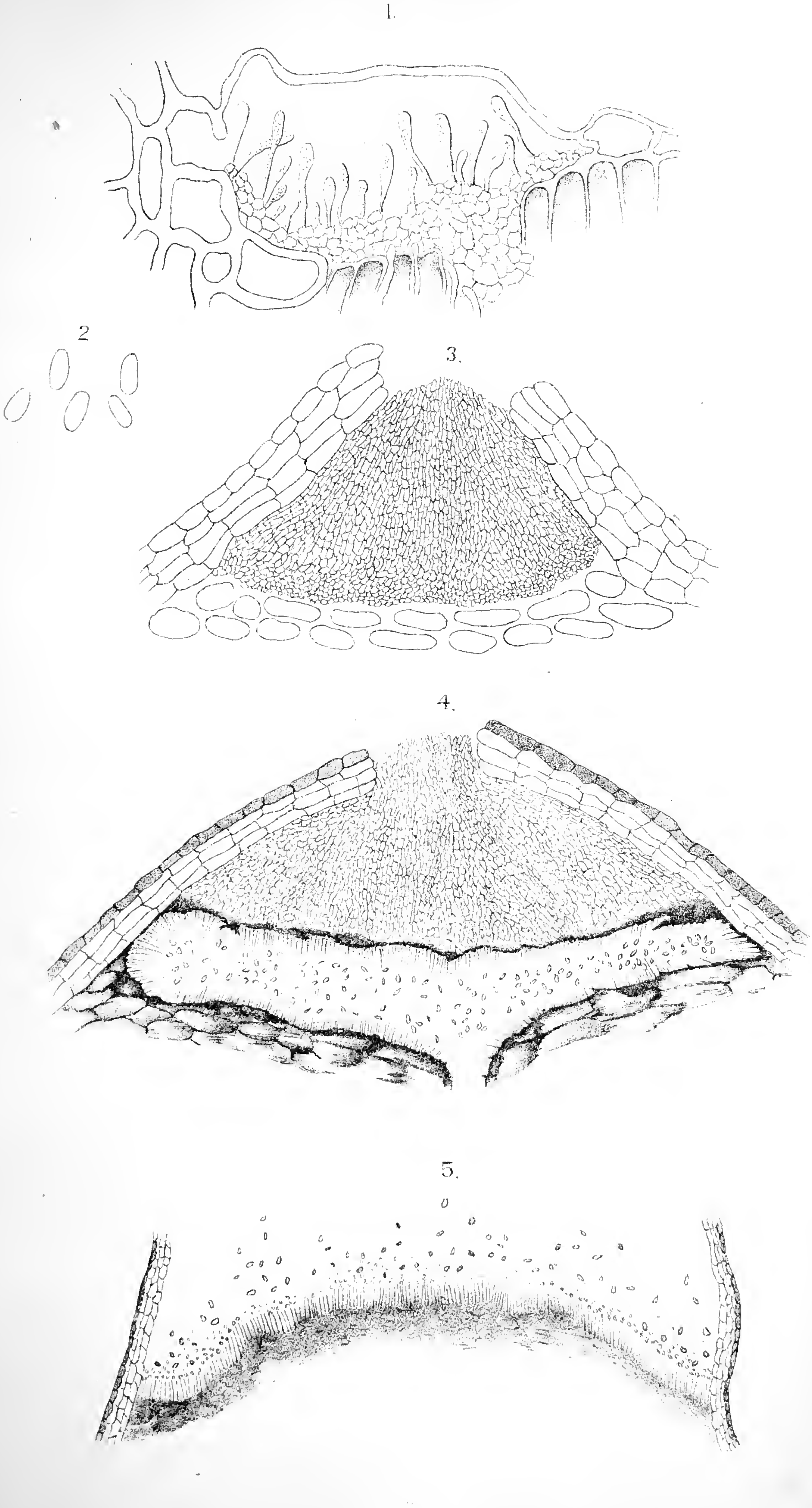
2. Spores. E. A. S., del.

3. *Diorchidium Tracyi*, uredospores. E. A. S., del.

4. Teleulespores. E. A. S., del.

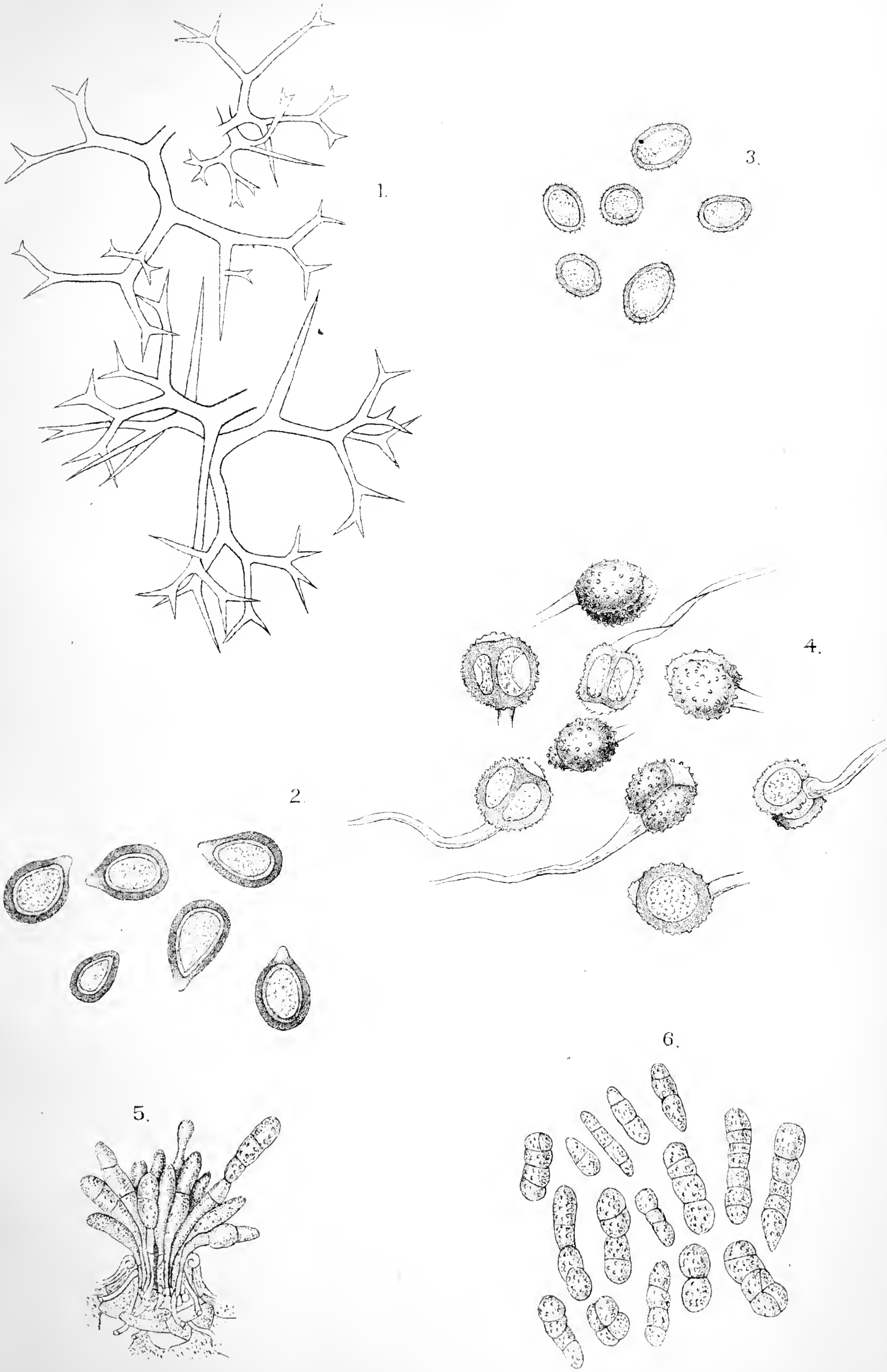
5. *Septosporium heterosporum,* tuft of conidia. After E. A. S.

6. Spores. After E. A. S.



VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

A. Hoen & Co. lith. Baltimore.



NEW SPECIES OF FUNGI.

A.Hoen & Co. Lith. Baltimore.

Compliments of

J. M. RUSK,

Secretary of Agriculture.

U. S. DEPARTMENT OF AGRICULTURE.
SECTION OF VEGETABLE PATHOLOGY.
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DEVOTED TO THE STUDY OF FUNGI, ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

B. T. GALLOWAY,
CHIEF OF THE SECTION.

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CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XI.)

By Franz von Tavel.

[*Continued from page* 58.]

III. Fenestella Platani, *n. s.*

Several dry branches of *Platanus* attacked by *Discula platani* and two forms of *Cytispora* were placed in moist air and left to themselves. It was the end of October before the observations could be taken up again. The *Cytispora* forms were still present, and between them protruded a number of long black necks of the perithecia of a Pyrenomycete not described in any of the systematic works which we used. It was, therefore, very minutely examined; its development could not, of course, be followed out completely, but it yielded some noteworthy results.

The starting point of the investigation was, as has been said, a form of *Cytispora*. The great variability of this form makes it doubtful whether or not it is identical with *C. platani*, described by Fuckel, E. F. N., No. 334. While still in the younger stages *Cytispora* shows itself on a branch in the form of small swellings 1–3 millimeters in diameter. The bark soon ruptures and the well known worm-shaped masses, which here have a waxy-yellow and often a whitish color, project through the openings. Upon removing them a black body, the stroma, may be seen through the crack in the bark. The stroma continues to increase in size, making the opening in the bark wider and then projecting through it. In the meantime new spore-masses protrude. The branches were kept in tall cylindrical jars containing some water at the base. It was apparent that the largest stromata existed at the base of the branches while the fungus developed very sparingly at the tips. It seems, therefore, that a high degree of moisture promotes the growth of the fungus. Fully-developed specimens of *Cytispora* often attain a diameter of one-half a centimeter; ten spore-masses may project from the stroma at the same

time. In old individuals the stroma frequently spreads over the surface of the branch, if only to a limited degree.

The structure of a fully-developed *Cytispora* is made clear by longitudinal and tranverse sections. The bark has been destroyed and broken through by a cone-shaped stroma which also sends hyphæ into the surrounding cells of bark parenchyma and breaks them down. This stroma is composed of a dense mass of irregularly-interwoven, coarse, brownish hyphæ. Within this are a greater or less number of cavities which are not surrounded in the young stages by specially-differentiated cell-layers, but in the older stages are inclosed by a brown or black wall; they are round at first, but finally irregular in form, possessing numerous folds and invariably lined with a hymenium. The development of the stroma begins from below and grows strongly toward the surface and a little toward the sides. The hyphæ at the apex which come in contact with the air swell up. * * * Even before the stroma has broken through the bark we can see in it dense knots of hyphæ distinguished by their transparency, which steadily increases after they attain their full size, which is very indefinite. The growth ceases in the interior while it continues at the periphery. Consequently cavities arise into which spore-forming hyphæ immediately grow from all sides. The pycnidia retain the power of growth for some time, and, therefore, frequently become adjacent or grow against obstacles so that their circumference is often very irregularly wrinkled. By the growth of the stroma they come to the surface, where their wall disintegrates and the spores escape. The pore, a special arrangement for the perforation of the wall, which is often present, is lacking in this case. The wall of the pycnidium arises from the knot of hyphæ and often can scarcely be distinguished from the stroma. In younger specimens it can usually be seen simply as a brown layer surrounding the cavity. In old specimens, however, and on pycnidia that have reached the surface, it often attains a considerable thickness and is dark brown or black. This is particularly the case with pycnidia, which together with the stroma extend over the surface of the branch. These protrude for a long distance out of the stroma; but the beginnings of the pycnidia occur only in the basal portion of the stroma.

The basidia are simple and filiform and cut off spores in immense numbers. The spores are one-celled, colorless, straight, and cylindrical. Their size is very variable; generally they are 3–4μ long and 1–2μ in diameter, but they have been observed 12μ long and 5μ in diameter.

It may be added here that the *Cytispora* under consideration is exceedingly variable. The size and shape of the stroma and pycnidia and the number of the latter are very inconstant. In view of this case too much care can not be taken in systematic investigations of this kind of fungi. The greatest weight should be laid on the form of the basidia and spores, since these show relatively the greatest constancy.

When the stroma of *Cytispora* has reached a certain size the forma-

tion of pycnidia gradually ceases, and is replaced by the development of perithecia; this occurs independently of the time of year, only requiring a sufficient amount of moisture. Moreover, only the feebly-developed stages of the *Cytispora* are found in the open air, and no perithecia at all.

The perithecia first appear at the base and are most numerous in the center of the stroma, while the pycnidia occupy the circumference. The first beginnings of the perithecia consist of small, globose knots of hyphæ, plainly visible on account of their greater transparency, which distinguishes them from the darker stroma. They are clothed on the outside by a layer of fine, delicate, brownish hyphæ, which are more or less parallel and run in the direction of the axis. The knots themselves consist of pseudo-parenchyma, whose cells are small and thin-walled but stronger than those of the outer layer. In what follows, the latter will be designated as the *outer* and the former as the *inner* perithecium wall. Within this pseudo-parenchyma an organ has been twice observed which might be called "Woronin's hypha" or perhaps an "ascogonium." In the first or younger stage it was, as compared with the surrounding tissue, a spirally coiled hypha with two turns and filled with dense protoplasm, which distinguished it clearly from its surroundings. The second case observed was of an older stage. The mass of tissue forming the young pycnidium was larger, but its structure was essentially the same. In this case the place of the pseudo-parenchyma was nearly filled up by a large coarse hypha which was wound up into a knot. It was no longer a simple spiral, but had a more complicated form. As far as could be made out it consisted of two or three coils, lying one within another, with simple ones at both the top and bottom. Here, too, the cell contents were denser than in the surrounding tissues. In this case some few cells were especially prominent on account of their size, but it could not be decided whether or not they were connected with the large hyphæ or were the beginnings of future asci.

In spite of a continued search we failed to observe any other stages. It is difficult to hit upon just the right stages of development, for thin sections of these stromata are not easily made, and the hyphæ in question may not always be so well developed. It therefore remains to be seen whether this hypha is directly connected with the formation of the asci; that is, whether it is an ascogonium or Woronin's hypha.

In older stages the circumference of the perithecium is considerably larger. A very rapid growth takes place at the apex, forming a perithecium neck which penetrates the stroma. The neck is for a long time of nearly the same diameter as the perithecium, and it is not until it projects above the stroma that the lower portion increases in circumference. The differentiation of tissues observed in the earliest stages can also be seen later on. The outer wall, whose hyphæ in the meantime have become coarser and browner, surrounds the entire reproductive body, and the neck is formed from it. It is composed of hyphæ which

are parallel to its long axis and which, diverging on the surface, clothe it with a kind of felt. The hyphæ on the inside which line the neck canal also bend outward and form hairs. These are all directed obliquely upward so as to permit the escape of the spores but to guard the entrance to the perithecium. In the older as well as the earliest stages the inner wall is composed of a colorless thin-walled pseudoparenchyma, and surrounds the entire cavity of the perithecium with the exception of the neck. The origin of this cavity and of the neck canal can not be definitely decided. The paraphyses and asci arise from the inner wall; the former are present in large numbers and are very long, slender, and thin walled. Their contents consist of finely granular protoplasm containing many globules that reflect the light.

In their earlier stages the asci are composed of extremely delicate club-shaped cells filled with strongly refracting protoplasm. Their wall remains very delicate even when they are fully grown. The form of the mature ascus is that of a cylinder, obtuse at the upper end and suddenly contracted below into a short, slender pedicel. It contains eight spores, which are oval, dark-brown, and three-septate at maturity. The two middle cells are each again divided by an oblique wall, which disappears when the spore is turned through an angle of 90° (Fig. 6). Very rarely there are a greater or less number of cell walls than stated above. The spores are slightly constricted in the planes of the septa, and the whole is surrounded by a thin, gelatinous layer. The length of the spore averages 14–18μ, the diameter 5–9μ.

The details of the perithecium having been fully examined, the point has been reached when the systematic position of the fungus should be more thoroughly considered. The main points upon which this depends are the following: The brown spores with their longitudinal and transverse septa; the presence of paraphyses; the existence of a stroma, if only an imperfectly developed one, which is certainly Valsoid, as is proved by the fact that it is very small in circumference and has perithecia projecting from the center and pycnidia from the circumference (Fig. 7). Of all known genera *Fenestella* is the only one which can be considered, since it is characterized by the above-mentioned points. Besides, there is no reason why the fungus should not be placed in this genus. It should be mentioned, however, that in most species of *Fenestella*, especially the native species *F. princeps*, the spores have many more septa; yet Saccardo mentions those having but few. This species differs from all other *Fenestellæ* in the great development of the neck, which gives it the appearance of a *Valsa*, and when the color of the spores is taken into consideration it stands very close to a *Pseudovalsa*. It may therefore be decided, merely on account of the longitudinal septa (which, as stated above, are visible only in a certain position of the spore) that it should be classified not as a *Pseudovalsa* but a *Fenestella*. Although the presence or absence of two walls is a very small matter in itself, and certainly one to which no great systematic value can

be attached, it would nevertheless, under the present system of classification, be impossible to do otherwise without revising the characteristics of an entire genus and rendering its position in Saccardo's artificial system impossible. These questions are for systematists to decide; in the present investigation it is perfectly immaterial whether its object is called *Fenestella* or *Pseudovalsa*.

As to the species, the one under consideration varies in the structure of its spores from all known species; that is, from all *Fenestella* and *Pseudovalsa* species cited in Saccardo's "Sylloge Fungorum." It can therefore be given the name of *Fenestella platani*.

The ascospores retain the power of germination for a long time. Material that had been kept dry for five months yielded the same results as that which was fresh. This question now suggests itself: Into what do the ascospores develop? The resulting body differs with the substratum. Cultures in nutritive solutions gave different results than those on fresh *Platanus* leaves. We will first follow the development of the fungus in a nutritive solution.

In water, in a nutritive solution like a decoction of the plum, grape juice, or extract of meat, or in some such solution thickened with gelatine, the ascospore germinates, as a rule, within twenty-four hours. Germ tubes arise sometimes from all, sometimes from only one cell in the spore. They penetrate the strong spore membrane, and the protoplasm passes from the spore into the germ-tube, giving the former a paler appearance. Generally the germ-tube swells up immediately after its exit from the spore; this is especially the case in water cultures where the fungus does not develop any further. In this case the germ-tubes generally remain quite short, sometimes becoming almost globose and beginning to cut off spores. Under favorable conditions they grow somewhat longer and even branch, but become divided up into short roundish cells and form gonidia at the apex (Fig. 8). These are oval, unicellular, and colorless. They soon put out a germ-tube, sometimes two, which again detach gonidia in a short time. Their further development was not observed.

In sowings upon gelatine which was mixed with a nutritive solution, the germ-tubes, unlike those sown in water, show a vigorous terminal growth, while their diameter increases very little; but even in this case the base remains thick and composed of short cells. The septa are formed at some distance behind the growing point, and numerous monopodial branches are also developed. On account of the large number of germ-tubes produced by the spore at the same time, and their vigorous growth, the mycelium attains a very considerable growth in a few days, in the center of which the dark-colored spore remains visible for some time.

After from five to six days some of the hyphæ which have come to the surface of the gelatine, or those that run just underneath it, send up numerous branches composed of one or two cells and bearing a pretty

large spherical head, the study of which is not easy. When placed in water it goes to pieces at once, leaving only a mass of colorless, cylindrical cells 3–5μ. long and 1–2μ. in diameter. The structure can be seen only when it can be observed in moist air under a cover glass. At the end of each branch of the mycelium is a globose, gelatinous mass, which swells strongly upon the addition of water and finally breaks in pieces. In it are imbedded a considerable number of the cells already mentioned, lying close together and parallel (Fig. 9). They have been cut off from the sporophore, and the gelatinous mass is composed of the envelopes of the individual gonidia.

The ascospore has therefore produced a gonidia-forming mycelium, a *Hyphomycetes*, belonging to the form *Acrostalagmus*, as is shown by the peculiar structure of the fruiting head. This form seems to be different from that of *A. cinnabarinus*, Corda. When very finely developed it has the appearance of a reddish mat, but the sporophores are never branched as in *A. cinnabarinus.* The spores of the latter are smaller than those of the form under consideration, but the development of the spores and the relations of the gelatinous envelope differ in no way from those of *A. cinnabarinus.* When *Acrostalagmus* was cultivated independently, its development was much more luxuriant; but pycnidia never made their appearance in these cultures; it seemed as if gonidia always reproduced the same gonidial form. It should also be mentioned that when the leaves were infected with ascospores *Acrostalagmus* nearly always appeared.

The development of sporophores and formation of spores continues on the *Fenestella* mycelium for a long time. The great masses of spores which fall off during the study of the fungus often makes this very difficult, and it is principally owing to them that the ascospores themselves are no longer visible.

Afterwards new changes occur in the *Fenestella* mycelium. A dense mat is generally formed by the repeated branching of the hyphæ and the formation of new ones from spores. This mat is called a stroma, although it deviates considerably from that formed in nature. At first the stroma of the slide cultures is not black or brown, but yellowish, which is probably caused by the rapid development incident to abundant moisture, for as a rule old cultures and those kept dryer take on a darker color. It can also be ascribed to the same cause, that the separate hyphæ are more delicate than those observed in nature. The outer form of an artificially produced stroma is therefore different from the natural one, and it can attain considerable dimensions if the substratum is a favorable one. Besides it does not have the conical shape described above, but forms a thin layer about 1 millimeter thick, upon, instead of within, which are the later formed pycnidia. We will return to this point farther on.

About three or four weeks after the sowing of the ascospores, numerous brown bodies, about 1 millimeter in diameter, which proved to be

pycnidia, made their appearance upon the stroma. They are usually arranged more or less in circles. In old stromata one often sees several concentric circles of pycnidia, since new rows are constantly being formed toward the circumference.

The pycnidia appear first as small knots of hyphæ; in certain places in the stroma the hyphæ wind much closer together; these points therefore appear darker, and are easily seen. These knots steadily increase in circumference for some time without any kind of differentiation. They represent merely small outgrowths of the stroma, nor do sections through this immature stage show anything but a homogeneous mass of hyphæ. Next, the young pycnidia begin to turn brown, that is, the outer layer of the tissue becomes dark colored and can be clearly distinguished as the rind. The remaining portion of the pycnidium remains unchanged until finally the hyphæ in the center move apart from each other, forming a small cavity (Fig. 10). This arises from the cessation of growth within the tissue, while the body continues to grow at the periphery. In this way the pycnidium develops into a spherical body containing a large cavity. Below, it is a little immersed in the stroma, but is distinctly separated from it by the outer layer. The wall is composed of two layers, the rind and a clearer layer within, also composed of irregularly interwoven hyphæ, without a trace of pseudo-parenchymatic structure. Immediately after the cavity begins to form, hyphal branches grow out into it and form a continuous hymenium. They cut off very small, cylindrical spores in great numbers. When the pycnidium is mature it ruptures in an irregular manner at the point, and the spores emerge in waxy, yellow, or whitish, worm-shaped masses.

In the preceding description a single pycnidium developing without any hindrance has been considered, but it is often the case that the first stages of any pycnidia arise close together. On account of the enlargement of the knots of hyphæ they collide, assume irregular forms, and grow together into various shaped bodies, yet in such a manner that the bounding lines of the individual pycnidia can be seen by the depressions between them. A rind following the depressions is formed on the outside; but within, the lateral walls are broken through by the formation of the cavities so that the compound body made up of many pycnidia possesses but one cavity. The depressions mentioned above correspond to projections upon the inside. The walls, consequently, appear wrinkled.

Now, are these pycnidia homologous with those with which the investigation started, the *Cytispora?* In the first place it may be stated that the form of the basidia and spores is the same in both, although they are as a rule a little smaller in the cultivated pycnidia. The structure of the walls agrees in the two, at least when the *Cytispora* pycnidia are young. The same things many be said of the older, black, and thick-walled pycnidia that have been said above concerning the stroma. The difference is more marked, because in the artificially produced specimens the pycnidia are superficial, while in the natural ones they are sunken

into the stroma. It has, however, been shown that in *Cytispora* individual pycnidia may project beyond the stroma. As regards the artificial ones we have only a variation dependent upon external conditions.

To this correspond the relations of the spontaneous *Cytispora* upon other substrata than twigs. Spores of the same kind were sown upon a well sterilized wilted leaf. The result was a stroma with pycnidia, having exactly the same appearance of that produced upon the slide. Infections of living and dead branches with *Cytispora* spores were without result.

It may also be mentioned that the circular arrangement of the pycnidia upon the slide points to a Valsoid stroma.

The beginnings of the pycnidia and their transformation into irregular chambers can not be so easily studied in the natural as in the cultivated *Cytispora*. But the results are in no way contradictory. In the natural *Cytispora*, also, the beginnings appear as knots of hyphæ of a globose form, which are by the least growth of the stroma brought very close together, and consequently must change their form and even coalesce on further growth.

What has been said suffices to show that there is no difference between the *Cytispora* and the pycnidia produced upon the slide, and that such variations as are present are traceable to the conditions necessary in culture methods; the two are therefore homologous.

Now since the beginnings of *Fenestella* perithecia have been formed directly upon the stroma of *Cytispora*, and the development of *Cytispora*, from the ascospore has been observed step by step upon the slide, the life history of the fungus is closed for us. That perithecia should be produced under the conditions necessary to the culture method was not to be expected. They would likewise have arisen in the form of knots of hyphae within the circle of pycnidia.

Although the pycnidia are extraordinarily small and spermatia-like, they possess the power of germination. In a suitable nutritive solution the spores swell up greatly and develop two or three germ tubes, which are much enlarged at their bases, so that afterwards it is often hard to say which is the swelling and which the spore. They proceed to branch like a budding fungus, afterwards one branch shows a strong growth at one end. Otherwise the mycelium develops in the same manner as from the ascospore.

The life history of the *Fenestella* is, however, by no means completed with what has been recorded. In order to prove whether the fungus was related to the *Cytispora*, sowings of the ascospores were made upon *Platanus* leaves and produced what is presumably a new stage of this pleomorphic form.

The spores were sown in a drop of water and this placed upon the lower surface of fresh young leaves and these kept moist. Germination was observed in a few days, but the penetration of the germ tubes was not seen. The inoculated parts began to turn brown without the fungus

becoming visible. Not until ten or fourteen days after inoculation, when the leaf had become brown and withered, did transparent points, which were most numerous along the nerves and less so upon the leaf surface, make their appearance. These points represent pycnidia, which are altogether different from those of *Cytispora*. They are situated under the epidermis, which they push up while their bases are more or less immersed in the leaf tissue. At the apex of the swellings the epidermis ruptures, forming an irregular roundish opening through which may be seen the ostiolum of the pycnidium, which will be described in detail below. The pycnidium is flattened and lenticular, yellowish in color, except the ostiolum, which is dark brown. Its walls, unlike those of the *Cytispora* (Fig. 11), are of a pronounced pseudoparenchymatic structure. They are clearly composed of two layers, the outer consisting of from one to three rows of flat cells with brown contents. Brown hyphæ usually originate from many of the superficial cells. This layer has a special structure at the apex of the pycnidium. It becomes much thicker and its cells take a radial direction, lying parallel to each other and forming papillæ-form projections on the surface. The papillæ are surrounded by a chaplet of long four or five-celled hyphæ, which arise from the outer cell and project beyond the epidermis. On account of the radial arrangement of the cells at this place the opening of the pycnidium will depend upon its time of maturity, since the cells are easily pushed apart. There is, therefore, here a similar arrangement to that in *Discula platani.*

Within this is a second layer of somewhat polygonal colorless cells which are flattened on the outside, but are more isodiametric within. The farther they are situated toward the interior the smaller their lumina. This layer bounds the cavity of the pycnidium, which is, however, very irregular, since the inner layer sends complex projections into it from all sides. From these, large round cells filled with dense contents arise everywhere. They are the basidia, but they do not form a continuous hymenial layer. They cut off oval (often rather cylindrical) unicellular colorless spores that measure 6–9 by 3–5μ.

These pycnidia are strongly characterized by the structure of their walls, and more especially of their apices, and the form of their basidia. Since little stress is laid upon these characteristics in systematic works, it was impossible to classify it in any existing genus. It would be superfluous to establish a new one, since in all probability it is only a stage in the life history of *Fenestella platani.*

Since the culture of these pycnidia in nutritive solutions was unsuccessful (concerning which more will be said) many questions relative to their development must remain unanswered. The youngest stage observed consisted of a knot of numerous coarse hyphæ (Fig. 12). It appears to originate from the *Cytispora*, although it is noticeably different from the beginnings of the *Cytispora* pycnidia. The number of hyphæ is smaller, but the hyphæ are proportionally stronger. Unfort-

unately it could not be determined whether the cell masses which projected into the cavity and bore a portion of the basidia are remnants of a ruptured tissue or whether they grow out from the inner layer of the wall after the formation of the cavity.

When sown upon gelatine and a nutritive solution the spores will in about twenty hours swell up and produce a germ tube. This develops into a mycelium of short-celled hyphæ whose growth soon ceases, while the cell contents become brown. In this way numerous more or less compact opaque masses of hyphæ are produced, which form a resting condition like sclerotia and may be called resting mycelia.

After remaining in a dry condition for some time these were again placed in a nutritive solution, the hyphæ masses began to grow again, but developed directly into an interwoven tissue and after a short space showed no further phenomena of growth.

But, on the contrary, if one of these resting conditions is placed on a leaf and kept moist the formation of pycnidia will follow. The pycnidia are therefore closely dependent upon the leaf, but this does not make them absolute parasites, since they only become apparent after the leaf is disorganized. Whether this disorganization was caused by the fungus or external causes is hard to say.

As already stated, the above described pycnidia which appear on the leaf are produced by sowing ascospores or by a perennial mycelium. They will develop also, however, if the spores formed in the pycnidia are sown on a leaf. Under the most favorable conditions of growth a pycnidia-forming mycelium arises from these, but under unfavorable circumstances a resting mycelium. Besides this the same pycnidia occurred after the sowing of *Cytispora* spores upon a fresh leaf, the latter being formed in a pycnidium produced under artificial cultivation. The manner of development of the pycnidia on the leaf was the same in all cases.

One important circumstance has not been mentioned. The pycnidia upon the leaves were in most cases accompanied by an *Acrostalagmus* form. But sowings of the latter on fresh leaves only produced the same form again.

We have now mentioned all the forms that could be obtained for observation which it is possible to suppose belong to the life history of *Fenestella platani.* The absolute proof of the connection between the ascospore and pycnidium is lacking in case of the pycnidia on the leaves. What has already been said makes it seem very likely that this stage is really connected with the *Fenestella.* As concerns the other forms, it is true that on the above grounds we can not trace the hyphæ from the gonidiophores of the *Acrostalagmus* back to the ascospores, still less can it be done for the later appearing pycnidia of the *Cytispora.* But the regularity with which both appear in all the cultures, and the similarity of the cultivated *Cytispora* pycnidia with the natural ones, leave no doubt as to their connection.

Aside from pycnidia on the leaves, the development of *Fenestella platani* is as follows:

The ascospores give rise to a mycelium which immediately cuts off gonidia—the *Acrostalagmus* stage. Later the mycelium develops into a stroma in which pycnidia are formed—the *Cytispora* stage. Finally perithecia break out of the stroma between the pycnidia—the *Fenestella* stage. Cultures of *Acrostalagmus* reproduced the same gonidial form, and no pycnidia; cultures of *Cytispora* both artificial and natural yielded the same pycnidia again. Under favorable circumstances, however, perithecia might be developed.

If the pycnidia that occur on the leaves really belong to *Fenestella*, then this fungus possesses both a parasitic and saprophytic cycle of development. The uncertainty which still exists in regard to this makes it undesirable to go farther in order to draw general conclusions.

(*To be continued.*)

PEACH ROT AND PEACH BLIGHT.

(*Monilia fructigena*, Persoon.)

By Erwin F. Smith, Sc. D.

For six years my attention has been drawn repeatedly to the serious losses resulting from the parasitism of *Monilia fructigena* upon plums and other stone fruits, and during the last three years my opportunities for observing its effect upon the peach have been unrivaled. These opportunities occurred principally in the great peach district lying between the Chesapeake and Delaware Bays. There, in the prosecution of the peach-yellows investigation, I have examined hundreds of orchards at all seasons of the year, and have incidentally made some very interesting observations on other diseases of the peach, particularly that resulting from the *Monilia*. It has also been my fortune to see this disease in the peach-belt of southwestern Michigan.

This fungus is more common, and far more destructive than any other observed on the peach in this country. It is rarely absent from the orchard, and in rainy weather it frequently destroys from one-half to three-fourths of the crop, in some cases the entire crop. Under its influence the fruit quickly loses its normal color and flavor, and becomes an entire loss to the grower. As the fungus invades the healthy tissues of the fruit the latter become leather-colored, or dark brown, and the peach is said to "rot," although, as Von Thümen first pointed out, the change is not strictly a rot. For the purposes of this paper it will, however, be convenient to follow the well-established popular usage and speak of this disease as the "peach rot."

So rapid are the changes induced by this fungus that sometimes the

greater part of entire varieties, representing thousands of dollars, may be lost in three or four days. At such times, fruit picked in an apparently sound condition is also very likely to rot on its way to market or in the hands of middlemen or consumers. Of late years peaches grown in Georgia and the far South have been especially troubled by rot during shipment. These peaches ripen in the hot weather of mid-summer and are sent long distances to Northern markets. The loss to Georgia growers is sometimes as much as two-thirds the whole crop. Could this rot be stopped the profit of peach growing the country over would be much increased—probably doubled. This general statement is based on observation and on inquiries among peach growers in a half dozen States. The peach is well known to be a delicate and perishable fruit, but it is not so generally known through just what agencies this decay occurs. An examination, however, of the fruit stalls in any city market, especially during hot and moist weather, will satisfy the most skeptical that this omnipresent fungus is the chief cause of the rapid decay, in fact, almost the sole cause.

Peaches uninjured by *Monilia* and missed in gathering sometimes hang on the trees several weeks, the skin remaining bright but the flesh becoming very soft and of a subvinous flavor. Fruit growers, as a rule, are entirely ignorant of the presence of any fungus. They do not know the cause of the rot but are painfully conscious of the result, since the latter can be expressed in pecuniary terms. The rot is frequently known as "scald" and is usually ascribed to hot and wet weather, but in this instance, as in many others, the weather is only a favoring condition, the real cause, the *sine qua non*, being the fungus, whose ash-gray spore-tufts are so often seen on the shrunken and discolored surface of the peach.

If the consensus of opinion among peach growers is of any value this rot is most uniformly destructive to early peaches, a very considerable portion of which rot every year. Whether this tendency in early varieties is due to a thinner skin, or to hotter weather during the time of their maturing, I am unable to say positively. It has been ascribed to the former and may in part be due to this, but I am not aware of any extensive series of observations made to determine the relative thickness or resisting power of peach skins. That this or some other unknown varietal peculiarity somewhat affects the spread of the disease is not improbable. I did think that certain of the early sorts, *e. g.*, Hale's Early, were specially subject to rot, but have given up this view as untenable. All the very early varieties rot badly, though in the same orchard not always to the same extent.

The well-known influence of moisture and especially of high temperature upon the rapid development of the fungus, facts which I have observed repeatedly in the orchard and have verified in the laboratory, lead me to think that the frequent rains and usual hot weather of July and the first part of August must be the principal reason why early

varieties always rot more or less, and generally much worse than middle or late sorts. It would, however, be a mistake to suppose that any variety is wholly exempt. Even sorts with the firmest flesh, *e. g.*, Troth's Early and Smock, perish very quickly if the meteorological conditions are favorable to the growth of the fungus. A single rain near the period of ripening will often immediately double or treble the number of rotting fruits.

It is also a great mistake to suppose the skin of the peach must first be punctured by insects or injured in some other way before the fungus can find an entrance. Every peach grower of long experience knows that this is not true, and any one can satisfy himself on this point by giving to the subject a little patient consideration. Injured fruits are more easily infected; that is all. In years of abundance only a small proportion of the peache which remain on the trees are punctured by the curculio or otherwise injured, yet the entire crop may rot very quickly during a rainy period, or during a series of hot days, with occasional rains or heavy dews. Moreover, in the laboratory I have infected the soundest peaches by merely sowing a few *Monilia* spores in a drop of water upon their surface, the control spots remaining entirely sound. To be most successful this experiment must be conducted in an atmosphere nearly saturated with vapor of water and at a temperature not much below 90° F. In the laboratory, as well as in the field, an increase in temperature of 10° to 20° above the normal causes an astonishing increase in the rapidity of the rot.

Some reference to the actual losses resulting from this rot during the autumn of 1888 will serve to show what happens not infrequently, and will afford ample basis for judgment as to the economic importance of restrictive measures.

The peach crop of the Delaware and Chesapeake Peninsula is well known to have been unusually abundant in 1888. I traveled extensively in six counties and saw for myself. All varieties fruited and the orchards bent under the weight of their precious burden. Even old, broken, neglected trees, in fence rows and pastures, were full of fruit. The early and middle varieties were gathered uninjured, except by a single windstorm, and were sold at prices ranging from 50 cents to $1.25 and upwards a basket. Until the end of the first week in September there was also every prospect for a very large crop of Smock and similar productive late peaches, which are planted very extensively for drying purposes. September 7 rainy weather set in over the upper part of the Peninsula, and continued almost uninterruptedly for five or six days. When it was not actually raining it was lowering and the air was full of moisture. These remarks apply especially to the counties of Kent and Cecil in Maryland and to Kent and New Castle in Delaware. At this date the Smock peaches were almost or quite ready to pick. The weather was not excessively warm, but the rain was so nearly continuous, and the spores of the *Monilia* were so widespread, that a veritable

epiphytotic ensued.* Every day thousands of baskets of green and ripening peaches rotted upon the trees and on the way to market.

In consequence of this rot the late peaches were nowhere very profitable, and in many instances were an entire loss. The daily railroad shipments, instead of increasing with the coming on of the Smock, fell off within a few days from scores of car loads to a few dozen, and must have fallen away almost to nothing had only sound peaches been shipped. The condition of much of the fruit forwarded during this week is sufficiently characterized by the following clipping from a Philadelphia daily of September 15:

The local peach market is utterly demoralized, not on account of the quantity of fruit but on account of the quality. No such mess called peaches was ever marketed before as has been arriving during the past few days. The season is practically ended and but few more good Delaware peaches will be received.

The total shipment of peaches over the Delaware Railway from September 9 to September 17 was but 711 car-loads; on September 14, 15, and 17, it was respectively only 46, 35, and 30 car-loads. None were shipped on Sunday, the 16th, and none of any consequence after the 17th. The shipments for four weeks previous to this time, August 13 to September 8, averaged about 195 car-loads per day. These spoiled peaches went begging at prices ranging from 7 to 25 cents per basket, the most of them being sold for 10 or 15 cents. At that time good fruit readily commanded 59 to 65 cents per basket of five-eighths bushel.

From intelligent and trustworthy peach growers on the Peninsula I have received many oral and written statements like the following, the amount of individual loss varying from a few baskets to many thousand, according to the acreage and the varieties planted:

In my orchard in Kent County, Md., probably 500 baskets (6,000 trees). In the county at large many thousands of baskets were probably lost.—[Dr. John J. Black, New Castle, Del.]

My own loss was perhaps 3,000 baskets.—[Dr. Henry Ridgely, Dover, Del.]

I lost 4,000 baskets.—[Norris Barnard, Still Pond, Md.]

My individual loss was not less than 2,000 baskets from an orchard of 6,000 trees.—[W. H. Burnite, Felton, Del.]

I am satisfied that my loss was from 5,000 to 6,000 baskets.—[James S. Harris, Still Pond, Md.]

My loss was about 7,000 baskets.—[Thomas D. France, Chestertown, Md.]

I lost from 10,000 to 15,000 baskets, 3,000 baskets rotting on their way to market.—[F. H. Harper, Still Pond, Md.]

In the week you speak of I lost 20,000 baskets. * * * We lost all our fruit that ripened after the Crawford's Late. The varieties lost will number at least one-half of all our orchards. In mine they represented two-thirds.—[Wilbur Eliason, Chestertown, Md.]

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* Aside from the repeated precipitation the principal peculiarity of the weather was the slight range of temperature. The variation at Dover during seventy-eight hours (a. m. of September 8 to p. m. of September 11) was only 14° F., while for the first thirty-six hours it kept between 70° and 82°, and did not at any time fall below 68°. After this the range was greater, but during the next five days the day temperature was above 70° four times and touched 83° on the 16th.

Mr. France estimates the loss in his county (Kent, Md.) at 400,000 baskets. Mr. Eliason (same county) also places the loss at 400,000 baskets. Mr. Harris (same county) thinks the loss was from one-fifth to one-sixth of the entire crop.

Norris Barnard estimates the loss on the Peninsula at one fourth of the whole crop. W. H. Burnite places the loss on the Peninsula at "one-sixth of the entire crop." Dr. Ridgely states that, at the time, the estimated money loss was $300,000.

Assuming the loss to have been only one-sixth of the total crop, and the value only 50 cents per basket, we have an approximate total loss of 800,000 baskets, worth $400,000. On first thought this seems like a rash or inflated statement. A personal acquaintance, however, with the orchards of this entire region, and a knowledge of the great extent to which Smock and other late peaches are planted, leads me to believe it is entirely warranted. In fact, it is probably under the actual loss, for in the upper part of the district in question these varieties are found in almost every orchard, while in many they include thousands of trees.*

This estimate is also established by the fact that in spite of the rot, and not counting the enormous number of peaches canned, dried, consumed, and sent away by water, the shipments from the Chesapeake and Delaware peninsula, by railroad alone, were upwards of 3,000,000 baskets (five eighths of a bushel), worth probably over $2,000,000—a crop only distanced by that of the famous year 1875, when the railroad shipments exceeded 4,500,000 baskets. But for the rot, the peach shipment of 1888 would undoubtedly have been nearly or quite equal to that of 1875, since in a productive year like 1888 the varieties which ripen after Crawford's Late are generally equal to about one-third of the whole crop.

This enormous loss of more than 800,000 baskets is to be attributed almost wholly to the destructive activity of the rot fungus. Could this fungus have been destroyed completely on the 1st day of September, or earlier in the season, the rot would not have appeared. Could it have been partially exterminated, the rot would have been proportionately less.

In this fungus the common mode of propagation from peach to peach, and the only known one, is by means of ash-gray conidia, which are produced in great numbers on the brown surface of the affected parts. These spores generally occur in little hemispherical tufts or confluent masses on bundles of hyphal threads which have burst through the skin of the peach. The mycelium ramifies abundantly in the decaying tis-

* Since this was written I have talked with Superintendent I. N. Mills, who informs me that the estimate of the railroad company's agent, after traveling over the territory in question, was 1,000,000 baskets, while the sum total of estimates sent in by the local freight agents was one-half greater. Mr. Mills himself places the loss at about 1,200,000 baskets.

sues and the number of conidial tufts visible on the surface seems to depend to a considerable extent on the amount of moisture in the air and on the length of time the peach has been affected. From these little, dusty, ash-colored tufts, which every peach grower must have observed, the infection is very readily transmitted to healthy peaches. Rains, winds, birds, insects, etc., all help to disseminate the spores and those which find suitable lodgment are very likely to germinate and extend the disease if the atmospheric conditions are at all favorable. Of course myriads of spores miscarry and other myriads perish before germination or during its progress, otherwise the peach and kindred fruits must long since have perished from the earth. Ample provision, however, has been made for the perpetuation of this parasite by endowing it with a fecundity which more than compensates for the small size and perishable nature of its spores. After some weeks, however, the conidia cease to be produced and the ash-gray tufts gradually disappear.

The disappearance of the conidial tufts is not, however, the end of the fungus. This winters over as a resting mycelium in the destroyed peaches which have either fallen to the earth or still hang upon the branches in a dry, wrinkled, mummified state. Early in the spring, if the atmospheric conditions are favorable, the fungus awakes to renewed activity—another crop of conidia is produced from new tufts borne on the old mycelium and the work of destruction begins anew. In the spring of 1889 I witnessed this for the first time, and was able to settle beyond doubt that the fungus winters over in the decayed fruits, especially in those which remain hanging upon the trees. This fact is one of great practical importance. The ordinary spores (conidia) being of a perishable nature it has occurred to many mycologists that *Monilia* must exist during a portion of the year under some other form—one capable of passing in safety through the inclement season. With this thought in mind I had been watching the fungus very narrowly for several seasons, but all to no purpose until May of this year. Then, thanks to a very rainy week, I came suddenly upon the explanation I was seeking.

Earlier in the year, when the peaches were in blossom and beginning to put forth their foliage, I was in the Delaware orchards, and was greatly perplexed to find the *Monilia* appearing suddenly everywhere on the blossoms and young fruit. This was first observed about April 29, in moist weather, soon after an unprecedentedly heavy and prolonged rain-fall.*

The orchards blossomed abundantly, but the greater part of the peach

*At Dover it poured continually for twenty hours (8 p. m. of 25th to 4 p. m. of 26th), and reports from the upper portion of the peninsula also indicated a very heavy rainfall. It also rained in showers on the 27th, all day. The precipitation at Dover from the first storm must have been at least six inches. A few peach-orchards were then in full blossom, but the majority were a day or two in advance and nearly or quite out of blossom.

crop in four counties was destroyed at this time. There had been no frosts of any consequence and the loss was generally ascribed to the rain. This was said to have washed off the pollen, but most of the orchards were just out of blossom when the rains began, and the real agent of destruction was the rot-fungus, favored, of course, by the excessive precipitation. The loss from this source in April and May, 1889, in all probability exceeded 500,000 baskets. The rot was also very bad in June and July. Hundreds of orchards in the upper portion of the peninsula produced no peaches whatever, and the railroad shipment from the whole district was only about one-half that of 1888.

Previously I was not aware that *Monilia* made its appearance so early. I had looked upon it rather as a summer or autumn fungus, but here it was in April.

Whence came the rot so suddenly? I could not tell; but in Maryland a few weeks later, during another rainy week, I saw all at once clearly what I failed to see in Delaware. This was May 16, when the young peaches were about the size of filberts or a little larger. From time to time all the winter and spring I had been inspecting the fungus-destroyed fruits of the previous season, hoping to find something. On this date I was working at another subject in a large orchard where fruit rotted the previous year. The prolonged rains had thoroughly softened the mummified peaches still clinging to the branches. Casually examining one of these, for perhaps the twentieth time, I was astonished to find its surface covered with the familiar conidial tufts. Previous to the rains I had been in that orchard, and there and elsewhere I had examined hundreds of the mummified fruits without finding a vestige of the spore-tufts of the previous summer. Indeed, the rains and winds generally destroy all traces before winter sets in, yet here they were as abundant and fresh in appearance as if grown from a newly-rotted peach. This discovery led to a careful search. On that day, and the wet ones immediately following, I found dozens of mummified fruits covered with the ash-gray tufts. In fact, about one-third of all I examined bore conidial tufts, and in no case were these the growth of the previous season. They had recently pushed from the interior of the rain-softened peaches, and they were particularly abundant after a prolonged, soaking rain. In a series of careful experiments under suitable control, I experienced no difficulty in infecting and rotting green peaches, plums, and cherries with conidia taken from these tufts. At that time, and especially some days later, great numbers of the young peaches perished from a natural infection during a continuance of the rainy weather, the mummified peaches being plentiful and their spore-dust abundant and easily disseminated.

My observations on this point confirm those made by Dr. J. C. Arthur on the cherry in 1885* and by Dr Paul Sorauer on the apple in 1889.†

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* Fourth An. Rep. N. Y. Agric. Exp. Sta. for 1885, p. 255.

†*Hamburger Garten- und Blumenzeitung*, 1889, Heft. I, p. 10–13.

They leave no doubt as to where and how this parasite passes the winter season.

This wide-spread and destructive fungus has naturally received considerable attention from mycologists, although the published accounts, especially the European, are somewhat meager. It is apparently more common and destructive in this country than in Europe, for it is not even mentioned in Winter's *Die durch Pilze verursachten Krankheiten der Kultur Gewächse*, or Von Thümen's *Die Bekämpfung der Pilzkrankheiten.* The summer form has been seen and described repeatedly, but no one has been able to connect these perishable organs with any other fungus, or to find resting spores. The cycle of development has remained hidden, and all attempts at prevention have therefore been simply gropings in the dark. Woronin has recently suggested that this fungus may be the conidial state of some *Peziza.* The fungus, for aught we know, may have an ascosporous form belonging to this or some kindred group, but such a form has never been seen and is unnecessary to the completion of its annual cycle. Moreover, if the fungus once produced asci, it may have lost this power during the lapse of ages. However this may be, it is certain that the mycelium which winters over in the dried tissues is amply sufficient to reproduce the plant each spring. This would still be true if it retained its vitality in only now and then a rotted fruit, for under favorable circumstances the mycelium in a single peach may produce a thousand or even two thousand conidial tufts, and each one is certainly capable of producing from five hundred to a thousand spores.

That the fungus may sometimes winter over in the twigs of the peach is also possible, for not only is the fruit destroyed in the manner just described, but sometimes growing shoots are also attacked and killed.

When the rot appears in the twigs it is commonly called "blight." I first discovered this blight in the summer of 1887, in Delaware, where it was unusually prevalent. Trees thus attacked present a very peculiar appearance, quite suggestive of blight in the apple and pear, only in the peach the destruction appears to be confined principally to twigs, the injury seldom extending to branches which have formed more than two annual rings. The reason for this is apparent, or at least not far to seek. Peaches are borne on very short pedicels on branches of last season's growth, and beyond their point of attachment there is usually from 3 to 18 inches of leafy elongating shoot axis, which will mature buds for the fruit and branches of the following season. In summer and autumn the blight of peach stems is always, or almost always, traceable to infection derived from mycelium. The spores do not figure here. This mycelium originates in the rotting peach; bores through the pedicel into the stem; ramifies in the latter, especially near the place of its entrance; and quickly destroys all the distal portion of the branch. Frequently the twig dies back a few inches further than the point of attachment of the peach, and sometimes a much greater dis-

tance, especially if all the foliage-bearing shoots are killed. The *direct* injury appears, however, to be confined principally to that part of the stem in the immediate vicinity of the peach. There the tissues of the stem are browned and killed by the parasite. The distal portion of the stem, the leafy shoot axis, often shows no trace of the fungus, but dries up as if girdled. Of hundreds of blighted stems examined in 1887, I saw none which were not associated with rotted peaches. Last summer and this summer I observed the same fact, although the blight was less prevalent. The earliest varieties blight most, and trees not in fruit never blight at this time of year. In the early spring, however, the young and tender shoots must be infected by spores. Many such shoots were attacked and killed in 1889.*

As a rule the fungus produces its conidial tufts much less frequently on stems than on fruit. Occasionally I have seen them on branches of the previous season's growth, but generally they are more abundant on tissues only recently out of the meristematic condition, *e. g.* on young stems in early spring.

This twig blight is well known to peach growers in Maryland and Delaware, and has been for years, although I have never seen any printed statement of the fact. In wet seasons it sometimes does more injury than the rot, because when many branches are destroyed the tree is not only injured, but the next year's crop is proportionately reduced. In some instances I have seen as many as one hundred blighted twigs on a single tree, the crown of green foliage being curiously interspersed with dead stems and withered leaves. Certain observant peach growers, to whom I mentioned the dependence of blight upon rot, assured me that they knew it already and could and did prevent it by promptly removing the rotting fruits. One man of large experience has known trees to be much injured by neglect of this precaution.

This paper, in which I have purposely avoided all questions of histology, would not be complete without some reference to means of prevention. The difficulties in the way of preventive treatment are great on account of the omnivorous nature of the fungus, yet I believe that they may be overcome and that a large measure of protection is quite within the range of possibilities.

I have quickly induced the rot in apples, pears, and peaches with spores taken from the plum; in cherries and plums with spores taken from the peach; in peaches and plums with spores taken from the cherry. The fungus infecting all these fruits is apparently one and the same. It occurs destructively on peaches, apricots, plums, and cherries, to some extent also on apples, pears, and quinces. It has also been reported as growing on grapes, gourds, the medlar, and *Cornus mas*. Dr. Arthur induced it to grow on blackberries, and Sorauer on green hazelnuts. I also found it to grow in green rose hips, but not vigorously,

* This blight must not be confused with that caused by a small larva which bores in the ends of the stems in early spring, and sometimes does considerable injury.

even under seemingly favorable conditions. The shrubby and arborescent *Pomeæ* and *Pruneæ*, especially the stone fruits, are the principal sources of infection. If we could control the disease in our orchards, the danger from outside sources would be slight.

The question of treatment naturally divides into two portions (*a*) orchard hygiene and (*b*) use of fungicides.

From what has been said it is apparent that two factors are necessary to the production of the rot:

(1) The presence of the rot fungus;

(2) The existence of meteorological conditions favorable to its rapid development.

The control of meteorological phenomena being impossible, the question arises: Can the rot be held in check by the destruction of the fungus? Fortunately we are able to give an affirmative answer. In this connection the importance of knowing where the fungus passes the winter becomes strikingly apparent. If its preservation through the winter and its reproduction in the spring depend wholly or in great part upon the existence of a dormant mycelium, then the systematic gathering and burying or burning of all rotten fruits in summer and autumn will very materially lessen the prevalence of the rot. Especially will this be true if the work of destruction is continued year after year as all work of this kind must be. The remedy here proposed rests on sound principles and is both practicable and practical. If applied on a large scale, systematically, throughout a peach district, and for a series of years, it could not fail to bring decided results. To be very successful it must be done thoroughly and by united effort. Too much stress can not be laid upon the removal and destruction of all the rotted fruits. *None must be left upon the ground or upon the trees.* Moreover, all the fruit-growers of a locality must unite if they would get the best results from this method, which is precisely that recommended for the extermination of noxious weeds, *i. e.*, allow none to go to seed.

Every husbandman knows that, in spite of thrift and painstaking, the farms of a whole community are threatened if only one man allows his fields to become the nursery of bad weeds. From the fields of this careless or negligent person the seeds of pestiferous plants are carried by animals, washed by rains, blown by winds, or transported by the hand of man outward in all directions, to curse the industrious. In the same way in dealing with this fungus one neglected orchard may furnish spores enough to reinfect all the surrounding orchards. In union only is there anything like safety. On the start it will be hopeless to expect united effort but this will come in time. Men who will not practice well-established rules of orchard hygiene ought to abandon fruit-growing. They are behind the times and in the wrong calling. Successful fruit-growing requires men of brains and decision. Prices are low, competition is severe, and, if any money is to be made, this business must be conducted intelligently in the light of all the knowledge

we can get. Even with united and unremitting zeal no more can be expected from orchard hygiene than would be anticipated from like efforts directed toward the extermination of a weed. With these provisos, it may be said that this method is full of hope. It is worth trying even if neighbors will not lend a helping hand, especially if other orchards are somewhat remote. Whether it will *pay* to struggle alone must depend on various contingencies, especially the price of fruit and the cost of labor. I am inclined to think it will, but this can be determined only by actual trial.

The proposed remedy is easy to put into operation. Every year when peaches are being picked a little additional labor would suffice to remove all the rotted and rotting peaches. The earlier this is begun the more secure will be the varieties next in order of ripening. Moreover, if at any time during the season a hot or rainy spell supervenes, and the fruit shows a tendency to rot before it is ripe, men should be put into the orchard *immediately* with instructions to remove every trace of rotting fruit. The same trees must be gone over again the next day, or the day after at furthest, so as to secure and remove all freshly rotted fruits, 24 to 36 hours being ample time to develop incipient cases not noticeable on the first gathering. The work must be done *very quickly and very thoroughly* in order that the rotting fruits may be removed and buried before the spores appear upon their surface to scatter destruction everywhere and undo all that has been done previously. Finally, in the late autumn, after the leaves have fallen, the entire orchard should be re-examined and all dried peaches lying on the earth or still clinging to the branches should be scrupulously removed and buried or burned.

I have so much confidence in the ultimate success of this method that I can not too earnestly urge its practice upon peach growers. If it were followed systematically for a series of years I believe the loss from peach rot would be reduced to inconsiderable proportions. This granted it is unnecessary to enlarge upon the resulting benefit to growers.

In regard to fungicides there is yet little to be said. Some experiments designed to preserve the fruit while on its way to market have been made by various growers. These indicate a possibility of delaying the decay some days by dipping into harmless sulphur compounds, *e. g.*, solutions of liver of sulphur, or of sulphur and cooking soda, and drying before packing into baskets for shipment. As an experiment, dry sulphur might also be dusted on the gathered fruit. All these methods are open to objection on the double score of cost and uncertainty. It is possible also that the spraying of some fungicide upon the trees and fruit will be found efficacious, but up to this time no fungicidal treatment appears to have been worked out to any satisfactory conclusion. Von Thümen recommends the repeated dry dusting of trees and fruit with sulphur, beginning in July. This might possibly answer the purpose, but the expense involved would be very considerable. So far

as I know it has never been tried in this country on any extended scale, but some experiments made this season by J. D. Husted, of Vineyard, Ga., gave favorable results. He dusted on sulphur twice, three weeks apart, using a bellows, and making the first application when the peaches were half grown. Probably as many as four applications should be made.

On the whole, the best hope of success appears to be offered by the method first outlined, *i. e.*, the prompt and persistent removal of sources of infection by the destruction of all rotting fruit; but the two methods might be combined.

ANOTHER SPHÆROTHECA UPON PHYTOPTUS DISTORTIONS.

By Byron D. Halsted.

As an addition to the note in the Journal of Mycology (Vol. 5, No. 1) upon the *Sphærotheca phytoptophila*, K. & S., found in the buds of the distorted branches of the hackberry (*Celtis occidentalis*), it may be said that the mature perithecia of the *Sphærotheca pruinosa*, C. & P., were found in abundance in the malformed inflorescences of the common sumach (*Rhus glabra*), caused by some species of a phytoptus mite. As far as can be learned the ascigerous fruit of this *Sphærotheca* is rare, although the leaves may frequently be attacked by the mildew and abound in the conidia. What is most interesting is that the fully developed perithecia were found among the abortive flowers as early as the middle of July and at a time when no fruit of this sort need be expected upon the leaves. This is another case of the abnormally developed part of a host being the most favorable for the growth of a parasitic fungus. It is perhaps to be expected that the tissue of a plant rendered more soft and irregular upon the exposed surface would supply the conditions for a vigorous growth of a mildew that is practically superficial. The spores would more easily be held in the niches of the distorted inflorescence and find the proper conditions for a rapid growth. It is also interesting to observe that this is also another *Sphærotheca*, which genus may have a particular fondness for the distortions of mites Have other phytoptous growths been found infested with members of the *Erysipheæ?*

NORTH AMERICAN AGARICS.

Genus *Russula* (*russulus*, reddish), Fr. Hym. Eur., p. 459.

By ROBERT K. MACADAM.

PART II.

III. RIGIDÆ.

12. "R. LACTEA, (Pers.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 118; Sacc. Syll., Vol. v., p. 459. Pileus 2 inches (5 centimeters) broad, at first *milk-white, then tan-white, throughout compactly fleshy*, campanulate then convex, often eccentric without a pellicle, always dry (at first even, then slightly cracked when dry), margin straight, thin, obtuse, even; flesh compact, white. Stem 1½–2 inches (4–5 centimeters) long, 1½ inches (4 centimeters) thick, solid, very compact, but at length spongy-soft within, equal, even, always white. Gills *free*, very broad, *thick*, distant, rigid, forked, white.

" Mild, the gills are at length adnate, forked at the base and apex. Care must be taken not to confound it with other *Russulæ* which have changed color and become white. In mixed woods. Uncommon. August.

"Name *lac*, milk. Milk-white. (Fr. Monogr., ii. p. 190; B. & Br., 1133; C. Hbk., n. 621; S. Mycol. Scot., n. 591; Ag., Pers. Krombh., t. 61, f. 1–2; Barla, t. 15, f. 1–13; Paul., t. 74, f. 2.)"—Stevenson.

Edible and of good flavor. North Carolina and Pennsylvania, Schweinitz; North Carolina, Curtis; California, Harkness & Moore; Wisconsin, Bundy; Ohio, in beech woods, Morgan.

13. "R. VIRESCENS, (Schæff.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 119; Sacc. Syll., Vol. v., p. 460. Pileus 2–4 inches (5–10 centimeters) broad, green, compactly fleshy, globose then expanded, at length depressed, often unequal, always dry, not furnished with a pellicle, wherefore the *flocculose cuticle is broken up into patches or warts*, margin straight, obtuse, *even;* flesh white, not very compact. Stem 1–2 inches (2.5–5 centimeters) long, ½ inch (12 millimeters) thick, solid, internally spongy, firm, *somewhat rivulose*, white. Gills free, somewhat crowded, sometimes equal, sometimes forked, with a few shorter ones intermixed, *white.*

" Edible. Taste mild. It varies in size and color of pileus, which is sometimes deep, sometimes pallid green, sometimes yellowish, then green. The gills are not so broad in front as those of neighboring species. It is very easily distinguished from all others except *R. crustosa*, by the green pileus being without a pellicle and innato-flocculose, then rivulose, and scaly in the form of patches. In woods. Frequent. July to September.—Stevenson.

"Stem variable in form, slightly reticulated with raised lines. Spores scarcely echinulate, almost globular, 6μ."—W. G. S. "Name—*Vireo*, to be green. (Fr. Mongr., ii, p. 190; Berk. Out., p. 212, t. 13, f. 6; C. Hbk., n. 632; S. Mycol. Scot., n. 592; Hussey, ii, t. 11; Ag. Schæff., t. 94, excluding f. 1; Vittad., t. 31; Sturm Deutschl, Fl., iii, 3, t. 31; Barla, t. 16, f. 10–12; Ventur., t. 17, f. 1, 2; Krombh., t. 67, f. 1–10.)"—Stevenson.

"Of various livid hues—yellow, purple, and green."—M. J. B.

"Specimens sometimes occur in which the margin is wholly or partly *striate*. The warts are sometimes pale brown."—Peck.

Of this Fries says "*antiquitus edulis.*" It is about the best edible mushroom we have, tender and of a fine nutty flavor. Its greenish cap, breaking up into *areas*, distinguishing it from all others except No. 28, *R. crustosa* (also mild), which has the same habit and is sometimes greenish. *R. furcata*, also with a greenish cap, but remaining *smooth*, is easily separated by its bitter taste.

North Carolina and Pennsylvania, common, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Farlow, Frost, Palmer; Minnesota, in woods, July, September, Johnson; New York, grassy grounds, June and July, Peck, twenty-fourth and thirty-third reports; Wisconsin, Bundy; Ohio and Kentucky, Morgan; Maryland, sometimes as large as a breakfast plate; Mississippi, Banning; New Jersey, Ellis.

14. "R. LEPIDA, Fr., Hym. Eur., p. 444; Stev., B. F., p. 119; Sacc. Syll., Vol. V, p. 461. Pileus 3 inches (7.5 centimeters) broad, *blood-red rose*, becoming pale, whitish especially at the disk, somewhat equally fleshy, convex then expanded, scarcely depressed, obtuse, opaque, unpolished, *with a silky appearance at length*, *often rimoso-squamulose*, margin spreading obtuse, without striæ. Stem as much as 3 inches (7.5 centimeters) long, 1 inch (2.5 centimeters) thick, *even, white or rose color.* Gills rounded behind, rather thick, somewhat crowded, often forked, connected by veins, white, often red at the edge. Edible. Taste mild; wholly compact and firm, but the flesh is cheesy, not somewhat grumous. The gills are often red at the edge, chiefly towards the margin, on account of the margin of the pileus being continuous with the gills. In mixed woods. Frequent. September to October.

"Name—*lepidus*, neat, elegant. (Fr. Monogr., ii, p. 191; Sv. ätl. Sv., t. 59; Berk. Out., p. 212; C. Hbk., n. 623; S. Mycol. Scot., n. 593; Hussey, ii, t. 32; Hogg & Johnst., t. 4; Ag. Krombh., t. 64, f. 19, 20; Batsch, t. 13, very small.)"—Stevenson.

Spores 8–10 by 6–8μ. Sacc. Syll. One of the best edible species. *R. emetica* and *R. rubra* (both poisonous) resemble this, but differ in having the pileus polished. North Carolina, in pine woods, Curtis; Massachusetts, Frost, Palmer; Minnesota, July, August, Johnson; Califonia, Harkness & Moore; Ohio, in beech woods, Morgan; New York, generally with the pileus red, but quite variable in this respect, woods, August. Peck, forty-first Rep.

15. "R. RUBRA, Fr., Hym. Eur., 444, Stev., B. F., p. 120; Cke., iii, 1025; Sacc. Syll., Vol. V, p. 462. Pileus unicoloros, cinnabar-vermilion but becoming pale (tan) when old, disk commonly darker, compact, hard but fragile, convex then flattened, here and there depressed, absolutely dry, *without a pellicle but becoming polished-even*, often rivuloso-rimose when old, margin spreading obtuse, even, always persistent; flesh white, *reddish under the cuticle.* Stem 2–3 inches (5–7.5 centimeters) long; about 1 inch (2.5 centimeters) thick; solid, even, varying white and red. Gills obtusely adnate, somewhat crowded, whitish then yellowish, with dimidiate and forked ones intermixed. Very *acrid*, very hard and rigid, most distinct from all the others of this group in the *pileus becoming polished-even*, although without a pellicle, in the *flesh being somewhat grumous* and in the *very acrid taste.* Gills often red at the edge. In mixed woods. Frequent. August to November. Poisonous. Spores whitish. Fr.; sphæroid, 8–10μ. K. Name—*ruber*, red. (Fr., Monogr., ii, p. 191; Sv. ätl. Sv., t. 49; Berk. Out., p. 212; C. Hbk., n. 624; S. Mycol. Scot., n. 594; Ag. Decand—Barla, t. 15, f. 1–10; Krombh., t. 65; Vitt. Mang., t. 38, f. 2, not Bull; Schaeff., t. 15, f. 4–6."—Stevenson. North Carolina, Pennsylvania, Schweinitz; North Carolina, Curtis; New York, July, Peck; Massachusetts, Frost; Minnesota in woods, July and August, Johnson; Wisconsin, Bundy; California, Harkness & Moore; Maryland, Miss Banning.

16. "R. FLAVIDA, Peck, 32d Rep. N. Y. State Mus. Nat. Hist., 1879, p. 32. Pileus fleshy convex, slightly depressed, unpolished, bright yellow; lamellæ white, adnate, turning cinereous; stem yellow, solid, white at the extreme apex."—Frost, M. S.

"Pileus 1–2 inches (2.5–5 centimeters) broad, fleshy, convex, then plane or slightly depressed, yellow, becoming paler with age; flesh white, the margin at first even, then tuberculate-striate; gills nearly simple, subdistant and broader before, adnate, white, the interspaces venose; stem 1–2 inches (2.5–5 centimeters) long, $\frac{1}{3}$–$\frac{1}{2}$ inch (8–12 millimeters) thick, short, equal or tapering upward, firm, glabrous, solid or merely spongy within, yellow; spores globose, 6–7.5μ in diameter.

"Taste mild. Gregarious. Grassy places in copses and open woods. Sandlake. July and August. The pileus is dry, and sometimes slightly mealy or granular. When young it is bright yellow; but it fades with age, and sometimes becomes white on the margin."—Peck.

This is one of the species found by Mr. Frost, but never published by him. Massachusetts, Frost; New York, Peck. Thirty-second Report and Bulletin, 1887.

17. "R. CINNAMOMEA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 4–6 inches (10–15 centimeters) broad, dry, fleshy, centrally depressed, cinnamon color, rimoso-squamose, the cuticle generally breaking up into flocci or granules; flesh dry, spongy, tinged with ocher. Gills concoloros, narrow, forked, close, sinuate near the margin. Stem 2–3 inches (5–7.5 centimeters) or more long, 1 inch (2.5 centimeters)

thick, regular, smooth, pallid, blunt, at first stuffed, then hollow; spores globose, 8μ in diameter. Taste acrid. In woods near Baltimore. June and July."—Ban.

IV. HETEROPHYLLÆ.

18. "R. VESCA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus *red-flesh color*, *disc darker*, fleshy, slightly firm, plano-depressed, *slightly wrinkled with veins*, with a viscid pellicle, margin at length spreading; flesh cheesy, firm, shining white. Stem *solid*, compact, externally rigid, *reticulated and wrinkled* in a peculiar manner, often attenuated at the base, shining white. Gills adnate, crowded, thin, shining white, with many unequal and forked ones intermixed, but scarcely connected by veins. Of middle stature. Taste mild, pleasant. In mixed woods. Frequent. September to October. Name, *vesco*, to feed. From its edible qualities. (Fr., Monogr., ii, p. 193; Sv. ält. Sv., t. 63; Berk. Out., p. 211; C. Hbk., n. 625; S. Mycol. Scot., n. 596; Hussey, i, t. 89.)"—Stevenson.

An edible species of fine flavor. Its peculiarly reticulated stem will assist in separating it from the noxious *R. rubra* which resembles it in the color of the pileus. California, Harkness & Moore.

19. "R. CYANOXANTHA, (Schæff.) Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus 2–3 inches (5–7.5 centimeters) and more broad, *lilac or purplish, then olivaceous-green*, disc commonly becoming pale, often yellowish; *margin* commonly *azure-blue or livid purple*, *compact*, convex, then plane, then depressed or infundibuliform, sometimes even, sometimes wrinkled or streaked, viscous, margin deflexed, then expanded, remotely and slightly striate; flesh firm, cheesy, white, commonly reddish beneath the separable pellicle. Stem 2–3 inches (5–7.5 centimeters) long, as much as 1 inch (2.5 centimeters) thick, *spongy-stuffed*, but firm, often cavernous within when old; equal, smooth, *even*, shining white. Gills rounded behind, connected by veins, not much crowded, broad, forked with shorter ones intermixed, shining white.

"Allied to *R. vesca* in its *mild*, pleasant *taste*, and in other respects, but constantly different in the color of the pileus, which is very variable, whereas in *R. vesca* it is unchangeable. The peculiar combination of colors in the pileus, though very variable, always readily distinguishes it. In woods, etc. Common. August to October. Sometimes considerably larger than Fries describes. Name, *χύανος*, blue; *ξανθός*, yellow. From the colors. (Fr., Monogr., ii, p. 194; B. and Br., n. 1131; C. Hbk., n. 626; S. Mycol. Scot., n. 597; Ag. Schæff., t. 93; Krombh., t. 67, f. 16–19; Paul., t. 76, f. 1–3.)"—Stevenson.

"One of the best esculent species. Spores 8–10 by 6–8μ." Sacc. Syll. "Intrinsically a margin with a rosy tone, more or less sobered with purple, a pale disk and between the two a dark zone of dull indefinable mixture of neutral green with purple, is the type, and the infinite variety is made up not of any change of colors, but simply of

their intensity."—Cooke. North Carolina and Pennsylvania. Common—Schweinitz.

20. "R. HETEROPHYLLA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 123; Sacc. Syll., Vol. V, p. 465. Pileus very variable in color, but *never becoming reddish or purple*, fleshy, firm, convexo-plane, then depressed, *even polished*, the very thin pellicle disappearing, margin thin, even or densely but slightly striate; flesh white. Stem solid, firm, somewhat equal, *even* shining white. Gills *reaching the stem in an attenuated form, very narrow, very crowded*, forked and dimidiate, shining white. Taste *always mild*, as in *R. cyanoxantha*, from which it differs in its smaller stature, in the pileus being thinner, even, *never reddish* or purplish, with a thin, closely adnate pellicle, in the *stem* being *firm and solid*, and in the *gills* being *thin, very narrow, very crowded*, etc. The apex of the stem is occasionally dilated in the form of a cup, so that the gills appear remote. In woods. Common. July to October.

"Edible, of a sweet nutty flavor. Spores echinulate, 5 by 7μ."—W. G. S. "Name, *Ετερος*, other, *φύλλον*, a leaf. With *gills of different* lengths. Fr.,) Monogr., ii, p. 194; Berk. Out., p. 211, t. 13, f. 5; C. Hbk., n. 627; S. Mycol. Scot., n. 598; Hogg. & Johnst., t. 9; Hussey, i, t. 84; Badh., i, t. 10, f. 3; ii, t. 3, f. 3, 4; Ag. Gl. Dan., t. 1909, f. 1; Paul., t. 75, f. 1–5)."—Stevenson.

Of the same edible qualities as the preceding; sometimes of a greenish-gray color. *R. furcata*, the only species of a disagreeable flavor having a green pileus, is distinguished by its uniform color and distant gills, as contrasted with the mottled tints and crowded gills of the former. North Carolina and Pennsylvania, in moist woods (*A. lividus*, Pers.) Schweinitz; California, Harkness and Moore; New York, in woods, August, Peck Thirty-fifth Report; Massachusetts, Palmer.

21. "R. CONSOBRINA, Fr., Hym. Eur., p. 447; Stev., B. F., p. 123; Sacc. Syll, Vol. V, p. 466. Pileus 3 inches (7.5 centimeters) broad, *dark-cinereous* or fuscous-olivaceous, fleshy, fragile, campanulate then expanded, at length depressed, margin spreading, even, though membranaceous; *flesh—white, cinereous, under the thick, viscous*, separable *pellicle*. Stem 2–3 inches (5–7.5 centimeters) long, almost 1 inch (2.5 centimeters) thick, solid, but *soft*, equal, even, smooth, shining, white, *at length becoming cinereous*. Gills at the first free, then appearing adnate when the pileus is flattened, broad, crowded, shining, white, *very many of them dimidiate and forked. Taste very acrid.* Not fetid. Stature in general that of *R. emetica*, but differing in the color of the pileus, and in the very unequal gills. In mixed woods. October. Spores granular 10μ. Q. Name—*consobrinus*, cousin. Distantly related to neighboring species. (Fr., Monogr., ii, p. 195; B. & Br., n. 1676; S. Mycol. Scot., n. 599.)"—Stevenson.

New York. "Our specimens are very variable in color, but the prevailing hues are green, olivaceous, and purple."—Peck. Twenty-sixth Report.

22. "R. FOŒTENS, (Pers.) Fr., Hym. Eur., p. 447; Stev., B. F., p. 124; Sacc. Syll., Vol. V, p. 467. Pileus 4–5 inches (10–12.5 centimeters) and more broad, dingy yellow, often becoming pale, thinly fleshy, at first bullate, then expanded and depressed, covered with a pellicle which is adnate, not separable and viscid in wet weather, margin broadly membranaceous, at first bent inwards *with ribs which are at length tubercular;* flesh thin, *rigid*—fragile, pallid. Stem 2 inches (5 centimeters) and more long, ½–1 inch (1–2.5 centimeters) thick, stout, stuffed, then hollow, whitish. Gills adnexed, crowded, connected by veins, with very many *dimidiate and forked* ones intermixed, whitish, at first *exuding watery drops.*

"Fetid. *Taste acrid.* Very *rigid*, most distinct from all others in its *very heavy empyreumatic odor.* In very dry weather the odor is often obsolete. The margin is more broadly membranaceous and hence marked with *longer furrows* than in any other species. It differs from all the preceding ones in the gills at the first exuding watery drops. The gills become obsoletely light yellow, and dingy when bruised."—Stevenson. "In woods, etc. Very common. July to September. Stem ruggedly hollow within as if eaten by snails."—M. J. B. "A very coarse and easily recognized species. Reckoned poisonous, though eaten by slugs. Spores minutely echinulate, almost globular 8μ."—W. G. S. "Name—*fœtens*, stinking. (Fr. Mongr., ii, p. 195; Sv. ätl. Sv., t. 40; Berk. Out., p. 213; C. Hbk., n. 628; S. mycol. Scot., n. 600; Ag. Pers.—Krombh., t. 70, f. 1–6; Viv., 41; Bull., t. 292; Ventur., t. 33, f. 1–3.)"—Stevenson.

"Variety *granulata* has the cuticle of the pileus rough with small granular scales."—Peck, Thirty-ninth Report. "The odor of this plant as it occurs with us is not usually fetid or unpleasant. It resembles the odor of cherry bark and might aptly be termed amygdaline, and the same odor has been attributed by one writer at least to the European *R. fœtens.* It is doubtless this form to which Dr. Curtis gave the name *R. amygdalina.* The lamellæ are rarely forked and frequently are quite as equal as in species of the section Fragiles."—Peck, Thirty-second Report.

North Carolina and Pennsylvania, plentiful, August, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Frost; New York, common in woods and open places, July and August, Peck, Twenty-third Report; Minnesota, July to September, Johnson; Wisconsin, Bundy; Ohio, generally rancid and stinking, sometimes fragrant, common, Morgan; Rhode Island, Bennett.

23. "R. SIMILLIMA, Peck, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 75; Sacc. Syll., Vol. V, p. 467; pileus, 1–3 inches (2.5–7.5 centimeters); broad, hemispherical or convex, then expanded, slightly depressed; at first or when moist viscid; the margin at length tuberculate-striate; pale, ochraceous yellow, the disk usually a little brighter colored; gills subequal, reaching the stem, some of them forked behind, venose-connected, yellowish from the first; stem 2–4 inches (5–10 cen-

timeters) long, $\frac{1}{3}$–$\frac{3}{4}$ inch (8–18 millimeters) thick; equal or slightly tapering upward, spongy within, rarely hollow, colored like the pileus, sometimes a little paler; spores, $\frac{1}{3000}$ inch (8 μ) in diameter; taste acrid. Ground in woods."—Greig. September.

"Allied very closely to *R. fœtens*, from which it differs by the absence of any marked odor and the margin not so widely striate. I have never seen it cæspitose; not growing in cleared lands."—Peck. Massachusetts, Frost; Wisconsin, Bundy.

24. "R. MORGANI, Sacc. Sylloge, Vol. V, p. 468. (*R. incarnata*, Morgan.) Pileus 3–4 inches (7.5–10 centimeters) broad, fleshy, firm; then very fragile, convexo-umbilicate; then expanded and depressed, moist, sordid, flocculose; the margin acute, not striate; the flesh thin, white. Stem about 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, solid, nearly equal, white. Gills adnate, distant, broad, and alternate ones dimidiate or mostly very short, white, then pale flesh color. Spores white, oblique, apiculate, smooth; 8–5.5μ.

"Taste mild. On the ground, under beech trees. July, August. The pileus is at first of a sordid color, brownish on the disk. The whole plant when mature takes on a sordid, fleshy hue, and becomes exceedingly fragile."—Morg.

Originally published as *R. incarnata* by Prof. A. P. Morgan in The Mycologic Flora of the Miami Valley, Ohio, (Journ. Cinn. Soc. Nat. Hist., April, 1883), but the title being preoccupied it was renamed as above.

25. "R. VARIATA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 3–4 inches (7.5–10 centimeters) broad, at first globose, then expanded and centrally depressed, smooth, viscid, variable in color and even variegated brownish or pinkish purple, with at times a cast of green; epidermis peels easily; the extreme under margin edged with a delicate line of purple; flesh white, unchanging. Gills white, adnexed, narrow, forked, close. Stem nearly 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, white, smooth, more or less tapering at the base, spongy within; spores white, echinulate, 7.5 by 7.5μ. Taste acrid. In woods near Baltimore. July."—Ban.

(*To be continued.*)

A NEW MUCRONOPORUS.

(Plate XII.)

By J. B. ELLIS AND B. T. GALLOWAY.

MUCRONOPORUS EVERHARTII. On living trunks of *Quercus nigra*, around Newfield, N. J. Found also by Mr. Everhart at West Chester, Pa., and sent from northern New Jersey by Prof. T. G. Gentry. Pileus dimidiate, zonate unguliform, broadly attached behind, convex above,

nearly plane below or convex behind and subconcave towards the margin, 6–12 centimeters wide and 6–8 centimeters long; margin subobtuse and clothed with a rich dark rhubarb-yellow thin tomentum, at length subglabrous. Pileus with 3–4 broad (2 centimeters) convex zones, the anterior margin of each zone disappearing beneath the posterior margin of the one before it, forming a concentric furrow between each two contiguous zones; surface crustaceous but not polished, becoming brownish black. Pores rhubarb-yellow with a changeable luster, equal, round, 110–120 μ in diameter, about 1 centimeter long, substratose, armed with abundant stout spines, 15–25 by 6–10 μ, mostly swollen at the base. Spores ferruginous, globose 3–3½ μ, or ovate-globose 3½–4½ by 3–3½ μ. Substance of the pileus (above the pores) corky leathery, rhubarb-yellow, repeatedly zoned, 2–3 centimeters thick, holding its thickness well towards the margin. The pores are not decurrent but are limited behind by a narrow definite margin; closely attached to the bark of the tree. What appears to be the same was found some years ago at Potsdam, N. Y., on beech. This differs from *Fomes rimosus*, Berk. in its pileus not rimose, in its rather smaller spores and spiny hymenium. In *M. igniarius* the spines are less abundant and shorter and spores hyaline.

NEW SPECIES OF KANSAS FUNGI.

By J. B. Ellis and W. A. Kellerman.

Phyllosticta viridis, *n. s.* On leaves of *Fraxinus viridis*, Rooks County, Kansas, September, 1888; (E. Bartholomew, 185). On large subindefinite (½–1 centimeter) spots visible on both sides of the leaf with a paler shaded margin. Perithecia hypophyllous, numerous, suberumpent, small, 65–80μ, of rather coarse cellular structure; sporules abundant, oblong, minute (2 by ½μ). The spots much resemble those of *P. fraxini*, E. & M., but that has sporules 5–7 by 2½–3μ and much larger epiphyllous perithecia.

Cytispora albiceps, *n. s.* On bark of *Juglans nigra*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1393). Tubercles semi-emergent, gregarious, ½ to ¾ millimeter, depressed-conic, opening by a single pore at the obtuse apex, which is covered with white granular matter, 5–6-celled, the cells at first filled with white granular matter and not readily distinguished. Sporules allantoid 4–7½ by 1¼–2μ. Basidia? Much resembles *C. leucophthalma*, B. & C., but the specimens of that species in Rav. F. Am., 698, have the tubercles less prominent and smaller and the sporules smaller (3-4 by 1μ). This also differs from *C. persicæ*, Sz., and *C. leucostoma*, Sacc.

Ascochyta sisymbrii, *n. s.* On *S. canescens*, Manhattan, Kans. (Kellerman & Swingle, 1221). Spots none; Perithecia scattered on

both sides of the leaf and on the petioles, black, innate, globose-depressed, 200–285μ in diameter, 100–195μ high, pierced above with an aperture about 20–25μ in diameter. Sporules vermiform-cylindrical, subhyaline, nucleate and mostly 1-septate, 18–45 by 3½–6μ, mostly 25–38 by 4–5μ. Not to be confounded with *Septoria sisymbrii*, Ell., which is on spots and has smaller spores.

Septoria aparine, *n. s.* On the lower dead and withered leaves and stems of *Galium aparine*, Manhattan, Kans., May, 1888 (Kellerman & Swingle, 1223). Perithecia minute, mostly 40–80μ but sometimes 160–208μ in diameter, scattered on the leaves and stems but not on spots. Sporules filiform, straight or subundulate, faintly nucleolate, continuous, acute at each end, 40–80 by 1½–2μ mostly 50–60 by 2μ. Differs from *S. psilostega*, E. & M., in not being on spots and in its shorter sporules and from *S. galiorum*, Ell. in its partially foliicolous growth, smaller perithecia and much longer spores.

Amerosporium subclausum, *n. s.* On fallen leaves of *Gymnocladus Canadensis*, May, 1888 (Kellerman & Swingle, 1232). Amphigenous, scattered; perithecia black, ovoid-globose 90–150μ in diameter, of coarse cellular structure with a round opening above fringed with spreading brown septate hairs, 60–220 by 5–8μ tapering above. Sporules oblong-cylindrical, obtuse, continuous, hyaline, 10–13 by 2–3μ. Differs from *A. polynematoides*, Speg. in the character of the perithecia.

Pestalozzia uncinata, *n. s.* On dead leaves of *Quercus tinctoria* dried up on broken limbs, St. George, Kans., June, 1888 (Kellerman & Swingle, 1269), with *Chætophoma maculosa*, Ell. & Morgan. Hypophyllus, gregarious, perithecia scutate, ¼ to ¾ millimeter in diameter. Spores oblong, pale, 4-septate, sometimes constricted at the second septum above, 18–22 by 5–7μ, with a short (5–7μ), stout, curved beak at the apex and a slender pedicel below 15–20μ long. Differs from *P. pallida*, E. & E., in its larger perithecia and spores.

Botrytis hypophylla, *n. s.* On living leaves of *Teucrium Canadense*, Manhattan, Kans., October, 1884 (M. A. Carleton, 142). Forming small white patches at first, soon effused over the entire lower surface of the leaf like a white tomentum. Prostrate hyphæ loosely interwoven, branching; fertile hyphæ erect, 30–150 by 2½–3μ, continuous, hyaline, subverticillately or rarely dichotomously branched above, the tips muriculate-lobate and bearing the globose 3½–4½μ conidia. *Cercospora ferruginea*, Fckl. occurs on the same leaves.

Botrytis cinereo-glauca, *n. s.* On wood under the bark of decayed logs of *Ulmus Americana*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1422). Forming a cinereous and somewhat glaucous continuous layer on the decaying wood under partially adhering bark. The repent hyphæ are branched and loosely interwoven, 2–2½μ wide, septate, sometimes slightly swollen above the septa, varying from nearly hyaline to somewhat dusky. Fertile hyphæ erect, 75–100 by 1½–2½μ wide, hyaline or somewhat dusky at base, at first sparingly and

later abundantly and irregularly branched, the branches usually straight and slightly tapering upward, terminated by a small cluster of oval-oblong 3–5 by $1\frac{3}{4}$–$2\frac{1}{4}\mu$ hyaline conidia.

OVULARIA CARLETONI, *n. s.* On *Lactuca*, Mitchell County, Kans., June, 1886 (M. A. Carleton, 141). Hypophyllous forming patches more or less distinctly limited by the veinlets 2–4 millimeters in diameter and of a pale yellowish color. The leaf is also marked on the upper side with pale yellowish indefinite spots. Hyphæ hyaline, 25–35 by 4–5μ, with offsets or shoulders on the sides marking the points where the conidia were attached, closely aggregated in minute tuberculiform masses. Conidia oblong-elliptical, hyaline, continuous, 12–15 by 6–7μ.

CERCOSPORA BARTHOLOMEI, *n. s.* On *Rhus toxicodendron*, Rooks County, Kans., September, 1888 (E. Bartholomew, 183 and 248*a*). Hypophyllous in inconspicuous, indeterminate, smoky-colored, scattered or subconfluent patches. Hyphæ fasciculate, straight or subundulate, nucleate, continuous or sparingly septate, reddish brown (under the microscope) 20–40 (mostly 24–34) by 4–6μ sometimes branched from near the base, tips entire or subdentate. Conidia nearly hyaline, varying from oblong to slender obclavate and from 20–120μ long and $2\frac{1}{2}$–3μ wide, nucleate becoming 3–8-septate, the shorter ones straight, the longer ones a little curved. This is very different from *C. toxicodendri*, Ell.

MACROSPORIUM BACCATUM, *n. s.* On old nuts of *Æsculus arguta*, Manhattan, Kans., March 1888 (Kellerman & Swingle 1239). Forms a dark olive thin but compact velvety coat on the nut. Fertile hyphæ sparingly branched or simple; torulose, 5–8μ in diameter, the joints occasionally swollen at intervals, nucleate. Conidia terminal, composed of rather loosely aggregated sub-globose cells, having an irregularly lobulated outline, somewhat resembling the fruit of a blackberry, very variable in shape and size, 16–40 by 8–27μ, usually without pedicels.

ZIGNOELLA DIAPHANA, (C. & E.). Sacc. var GRACILIS, *n. var.* On decayed log, Manhattan, Kans., June, 1888 (Kellerman & Swingle 1249). The sporidia are acutely elliptical, 3–4-nucleate, hyaline 11–$12\frac{1}{2}$ by 5–6μ, and like those in our specimens of *Z. diaphana* (although Saccardo, in Syll. II, 220, gives the size as 20 by $7\frac{1}{2}\mu$), but the asci, which are 75–87 by 6–9μ, are larger; and the perithecia, which are mostly 120–240μ in diameter, and globose-conic or subrostrate, are smaller and more acute. Possibly it should be assigned specific instead of varietal rank.

NEW AND RARE SPECIES OF NORTH AMERICAN FUNGI.

(*Sphæropsideæ.*)

By J. B. Ellis and B. M. Everhart.

Phyllosticta pyrolæ, *n.s.* On living leaves of *Pyrola rotundifolia*, Centreville, Del., July, 1873. A. Commons, 906. Spots amphigenous reddish brown, orbicular with a narrow, slightly raised margin, 1½–2 millimeters in diameter. Perithecia epiphyllous, erumpent, globose, 100–112μ in diameter. Sporules ovate-globose, hyaline, 5–6μ in the longest diameter.

Phyllosticta humuli, Sacc. & Speg. var. major, E. & E. On hop leaves, Iowa, June, 1889, A. S. Hitchcock. Differs from the type in its larger (12–16μ) sporules. Spots dull rusty white, becoming whiter, 2–3 millimeters in diameter, suborbicular, with a narrow, raised border. Perithecia epiphyllous, innate, yellowish, (80-90μ). Sporules 12–16 by 4–5μ with 1–3 nuclei.

Phyllosticta rhei, *n.s.* On *Rheum officinale*, Newfield, N. J., August, 1889. Spots mostly marginal, subconfluent, large (1–2 centimeters), rusty brown, concentrically zoned, either with or without a definite, slightly darker limiting line, around which is a broad border of light yellow. Perithecia innate, visible on both sides of the leaf and slightly prominent, rather large (100–150μ), not abundant. Sporules oblong-elliptical, 2-nucleate, rounded at the ends, hyaline, 5–7 by 2–2½μ, resembling the sporules of some *Phoma*.

Phyllosticta variegata, *n. s.* On leaves of *Fraxinus*, London, Canada, July, 1889. J. Dearness, 519. Spots numerous, angular, pale yellow, 1–3 millimeters in diameter, with a definite, narrow, darker margin. Perithecia epiphyllous, lenticular, black, 90–100μ. Sporules ovate or elliptical 4–5 by 1½–2μ. *Phyllosticta fraxini*, E. & M., which is doubtfully distinct from *P. fraxinicola*, Curr., has larger sporules (5–7 by 3μ) and larger darker spots. *P. viridis*, E. & K., is also quite different from this.

Phyllosticta macluræ, *n. s.* On leaves of *Maclura aurantiaca*, Newfield, N. J., August, 1889. Spots dark red-brown, subirregular and subindefinite, often marginal and confluent, ¼ to 1 centimeter in diameter. Perithecia epiphyllous, prominent, ⅓ millimeter in diameter. Sporules ovate-oblong or fusoid-oblong 2–4-nucleate 10–12 by 3μ.

Phyllosticta calaminthæ, *n. s.* On *Calamintha clinopodium*, London, Canada, August, 1889. J. Dearness, 372. Spots amphigenous, definite, round 1–2 millimeters in diameter, nearly black, becoming whitish, thin. Perithecia few lenticular, epiphyllous, pierced above, 80μ in diameter. Sporules elliptical, hyaline, 2-nucleate, 3½–4½ by 2–2¼μ.

Phyllosticta hydrangeæ, *n. s.* On leaves of *Hydrangea* (cult.). Spots 1½ to 1 centimeter or more in diameter, rusty brown, with a nar-

row raised border, shaded with purple at first. Perithecia epiphyllous, lenticular, pierced above 100–115μ in diameter. Sporules oblong, 2–3-nucleate, hyaline, 10–12 by $2\frac{1}{2}$–$3\frac{1}{2}\mu$.

PHYLLOSTICTA ORONTII, E. & M. var. ADVENA, E. & E. On leaves of *Nuphar advena*, London, Canada, July, 1889. J. Dearness, $293\frac{1}{2}$. Spots subelliptical 1–$1\frac{1}{2}$ centimeters, pale yellow, more or less concentrically wrinkled, with a narrow, definite, slightly raised border. Perithecia epiphyllous, innate, dark, slightly prominent, on a lighter colored, thinner, definitely margined spot in the center of the larger spot. Sporules oblong, 5–8 by $2\frac{1}{2}$–3μ, ends obtuse.

PHYLLOSTICTA HALSTEDII, *n. s.* On living leaves of *Syringa vulgaris*, New Brunswick, N. J., July, 1889. Dr. B. D. Halsted. Spots amphigenous; subrotund; red-brown; $\frac{1}{4}$ to $1\frac{1}{4}$ centimeters in diameter; concentrically wrinkled or zoned, with a definite, narrow, dark border. Perithecia few; lenticular 100–150μ, in diameter; innate; generally visible on both sides of the leaf. Sporules broad, fusoid-oblong, not curved; granular; 15–20 by 5–7μ; ends rounded. The specimens of *Phyllosticta syringæ*, West, in De Thümen's Mycotheca 1490 agree very well with the description in Sylloge, having sporules 6–8 by $2\frac{1}{2}$–3μ, but specimens in Fungi Gallici 135 are the same as the New Jersey specimens; spots concentrically wrinkled, and sporules 15–20 by 5–7μ. De Thümen's Mycotheca, 1672, on leaves of *Syringa Chinensis*, does not seem to be a *Phyllosticta*.

PHYLLOSTICTA DESMODII, *n. s.* On leaves of *Desmodium*, Walworth County, Wis. July, 1888. Dr. J. J. Davis, 47. Spots amphigenous, suborbicular or irregular; 2–5 millimeters in diameter; often more or less confluent; dark brown, becoming whitish in the center, at length more or less fissured and cracked. Sporules oblong, elliptical, hyaline, $3\frac{1}{2}$–5 by $1\frac{1}{2}$–2μ.

PHYLLOSTICTA PALMETTO, *n. s.* On leaves of *Sabal palmetto*, Louisiana, April, 1886. (Langlois, 426 in part.) On the same host at Leland, Miss., April, 1889 (Tracy, 1206). Spots subelliptical $\frac{1}{2}$ to 1 by $\frac{1}{4}$ to $\frac{1}{2}$ centimeter, pallid, with a yellowish shaded border. Perithecia amphigenous, pustuliform, 110–150μ in diameter, lead colored, of fine cellular structure, with a small round opening in the center. Sporules cylindrical; obtuse 2–3-nucleate, hyaline, 12–14 by $2\frac{1}{2}$–3μ. The perithecia resemble minute blisters. Probably the spermogonial stage of *Sphærella sabaligena*, E. & E., with which it was mixed in the Louisiana specimens.

PHYLLOSTICTA DEUTZIÆ, *n. s.* On leaves of *Deutzia* (cult.). Spots amphigenous, light brown or whitish, round, 1–2 millimeters in diameter, with raised border on both sides of the leaf. Perithecia lenticular, black, mostly epiphyllous, nearly superficial, $\frac{1}{5}$ millimeter in diameter. Sporules subelliptical, fuscous, 4–5 by 3μ.

PHYLLOSTICTA COMMONSII, *n. s.* On leaves of *Pæony*, Wilmington, Del., June 24, 1889. A. Commons, No. 922. Spots pale yellowish, defi-

nite, 3–4 millimeters in diameter. Sporules oblong or elliptical, smoky hyaline, 4–5 (exceptionally 6–7) by 2–2½μ. Differs from *P. pæoniæ*, S. & S., in its definite spots and smaller (75–80μ) perithecia and in its smaller sporules.

MACROPHOMA SUBCONICA, *n. s.* On dead stems of *Solanum nigrum*, St. Martinsville, La., November, 1888. Rev. A. B. Langlois, 1569. Perithecia innate-erumpent, conical, ½ to 1 millimeter high. Sporules elliptical, hyaline, 20–2? by 14–16μ. On slender basidia about as long as the sporules. Also on *Alocasia esculenta*, No. 1576.

PHOMA MEDIA, *n. s.* On dead stems of *Asparagus*, Newfield, N. J., April, 1889. Perithecia occupying an elongated spot 6–8 centimeters long and 1 centimeter wide, large (½ millimeter), depressed-globose, or slightly oblong, with a distinct papilliform ostiolum which is soon broadly perforated. Sporules fusoid, straight, hyaline, 2-nucleate, acute, about 10–12 by 2½μ. *P. asparagi*, Sacc., is on bleached parts of the stem and has smaller obtuse sporules. In this the surface of the stem beneath the leaden-colored epidermis is more or less blackened. *P. lanceolata*, (C. & E.) has the sporules 20–24 by 5μ.

SPHÆRONEMA CANUM, *n. s.* On dead branches of *Negundo aceroides*, Manhattan, Kans., February, 1889. Kellerman & Swingle, 1318. Perithecia at first covered by the bark, depressed hemispheric, 1 millimeter or over in diameter, with a central, cylindrical, stout, straight, black beak about 1 millimeter high with a slightly enlarged, subovate, gray, strigose head. Sporules ovate-olong or ovate-elliptical, nucleate, hyaline, 7–10 by 3–4μ, on cylindrical basidia 15–20 by 2μ, and forming a compact, whitish horn-colored stratum within the perithecia. The general appearance of the fungus is much like that of *Stilbum giganteum*, Pk., or perhaps resembles more closely *Sphæronema pruinosum*, Pk., but this is quite distinct from either of those species.

HAPLOSPORELLA EUONYMI, *n. s.* On dead limbs of *Euonymus atropurpureus*, Lincoln, Nebr., March, 1889; H. J. Webber. Stromata scattered or seriate, erumpent, and loosely surrounded by the ruptured epidermis, hemispheric or oblong, 1–2 millimeters in diameter, subtruncate, and finally whitish above. Perithecia entirely inclosed in the stroma, with thin subevanescent walls, and appearing on a cross-section more like cells than like perithecia; ostiola obscurely papilliform. Sporules oblong, obtuse, very slightly narrowed in the middle (possibly becoming 1-septate), 10–14 by 6–8μ, brown, on slender basidia, 70–80μ, long. On the smaller twigs the stromata are smaller, but the sporules larger, 18–22 by 10–12μ. *Sphæropsis valsoidea*, (C. & E.) has exactly the same structure and should be *Haplosporella valsoidea*, C. & E.

HAPLOSPORELLA AILANTHI, *n. s.* On dead *Ailanthus glandulosus*, Lyndonville, N. Y., May, 1889; Dr. C. E. Fairman, 61. Perithecia large (¾ millimeter); aggregate cespitose, buried in the bark and connected by an imperfect stroma, subseriately erumpent. Sporules ovate or elliptical, dark brown, 18–22 by 8–10μ, filled with white grumose matter.

Ascochyta silenes, *n. s.* On leaves and stems of *Silene antirrhina*, Racine, Wis. June 1888, Dr. J. J. Davis, 23, and on the same host collected by Mr. F. W. Anderson (No. 350) in Montana. Spots pale yellowish, the entire leaf finally assuming the same color, the spots which are then hardly discernible becoming paler. Perithecia erumpent discoid, 120–150μ in diameter, broadly pierced above, not confined to the spots but scattered over the entire leaf. Sporules oblong, hyaline, 2–3 nucleate, rounded at the ends 10–14 by $2\frac{1}{2}$–3μ. In the Wisconsin specimens *Septoria saponariæ*, (D C.) occurs also on the same leaves, but may be distinguished with the naked eye by its paler perithecia. This differs from *Phyllosticta nebulosa*, Sacc., in its larger scattered perithecia and larger sporules. The specimens of *P. nebulosa* in Saccardo's Mycotheca Veneta (in our copy) are a *Sphærella* with clavate-oblong, inequilateral 35 by 15μ asci and crowded, oblong-fusoid 1-septate 12–15 by 3–$3\frac{1}{2}\mu$ sporidia.

Ascochyta? infuscans, *n. s.* On leaves of *Ranunculus* (*abortivus?*), London, Canada, July 18, 1889; J. Dearness, 256. On large, dark brown, indefinitely limited areas of the leaf, causing faintly zonate indefinite spots, in which are buried the brown perithecia, slightly raising the surface of the leaf in a pustuliform manner. Sporules oblong, hyaline, obtuse, narrowed in the middle, with two large nuclei 10–15 by 4–6μ (becoming uniseptate?).

Ascochyta thaspii, *n. s.* On leaves of *Thaspium barbinode*, London, Canada, August, 1889; J. Dearness, 511. Spots amphigenous, suborbicular, dirty brown, with definite margin, surrounded by a narrow yellow border, about $1\frac{1}{2}$ centimeters in diameter. Perithecia innate, pale, 100–120μ in diameter, entirely buried in the substance of the leaf and scarcely visible. Sporules cylindrical 1-septate (3–4 nucleate), 25–30 by 6–8μ, ends rounded and obtuse.

Ascochyta alismatis, *n. s.* On leaves of *Alisma plantago*, London, Canada, August, 1889; J. Dearness, 512. Spots amphigenous, round, small (1–2 millimeters), dirty brown, whitish in the center, surrounded by a faint yellowish discoloration. Perithecia innate, pale, 80–100μ, with a broad opening above. Sporules oblong cylindrical, 12–16 by $2\frac{1}{2}$–3μ, 2-nucleate becoming 1-septate.

Ascochyta cornicola, Sacc. This seems to be quite variable in the size of the sporules. Saccardo says 7–10 by $3\frac{1}{2}$–4μ. Specimens on leaves of *Cornus sericea* sent from Wisconsin by Dr. J. J. Davis have sporules 7–11 by 5–6μ. Specimens from Ohio sent by Professor Morgan have sporules 10–15 by $3\frac{1}{2}$–4μ. *Phyllosticta cornicola* does not differ in any respect, except that the sporules are not septate, and is probably a less perfectly developed state of *Ascochyta cornicola*.

Asteroma ribicolum, *n. s.* On living leaves of *Ribes floribundum*, Helena, Mont., August, 1888; Rev. F. D. Kelsey, No. 210. Epiphyllous. Fibrils branching and radiating from a central point, forming

dark-colored orbicular spots 1 centimeter or more in diameter. The lower surface of the leaf opposite is also of a darker color. The fibrils are closely appressed, and except towards their vanishing extremities are thickly covered with the minute black sterile perithecia.

CONIOTHYRIUM CEPHALANTHI, *n. s.* On living leaves of *Cephalanthus*, Bayou Chene, La., October, 1888; Langlois, 1532. Spots large, suborbicular, or irregular; grayish-brown above, rusty brown below; often subconfluent over a large part of the leaf, all more or less distinctly concentrically zoned. Perithecia hypophyllous, minute, abundant, erumpent, black. Sporules brown, continuous, globose, 4–5μ in diameter, or ovate, 4–5 by 3–3½μ.

SPHÆROPSIS SMILACIS, *n. s.* On dead stems of *Smilax hispida*, Lincoln, Nebr., November, 1888. H. J. Webber, 34. Perithecia scattered, buried in the substance of the bark, bursting the cuticle, but only partially erumpent. Sporules oblong, brown, obtuse, 15–20 by 6–8μ.

SPHÆROPSIS CLADONIÆ, *n. s.* On apothecia of *Cladonia cariosa*, Emma, Mo., March, 1889. Rev. C. H. Demetrio. Perithecia minute, about $\frac{1}{6}$ millimeter in diameter, and a little more than that in height, obconic-cylindrical, subtruncate above. Sporules globose, or obovate-globose, yellowish-brown, about 3μ in diameter, on stout basidia about 6 by 2μ. Differs from *S. parasitans*, B. & Rav., in its differently shaped smaller perithecia and sporules.

HENDERSONIA HETEROPHRAGMIA, *n. s.* On dead twigs of *Sarcobatus vermiculatus*. Near Great Falls, Mont., July, 1889. F. W. Anderson, 541. Perithecia erumpent, superficial, subseriate, globose, collapsing, $\frac{3}{4}$ millimeter in diameter. Ostiolum papilliform. Sporules elliptical or oblong elliptical, brown, 1–3-septate 12–16 by 5–7μ.

HENDERSONIA CONCENTRICA, *n. s.* On living leaves of *Rhododendron catawbiense*, Roan Mountain, North Carolina, July, 1889. Prof. F. L. Scribner. Spots exactly as in *Pestalozzia concentrica*, B. & C., marginal, 1–2 centimeter in diameter, variegated with alternate lighter and darker zones, margin definite, but not raised. Sporules fusoid-oblong, pale-brown, 3-septate, 12–15 by 3μ, on slender basidia 20–30μ. long. Acervuli mostly erumpent above, black. On *Rhododendron maximum* from the same locality, the fungus occurred on large dead areas of the leaf, and the concentric zones were scarcely discernible.

HENDERSONIA DAVISII, *n. s.* On partly dead leaves of *Carya alba*, Racine, Wis., August, 1888. Dr. J. J. Davis, 10. Spots large, occupying the entire upper half of the leaf, dark brown. Perithecia mostly epiphyllous, gregarious, black, erumpent $\frac{1}{8}$ to $\frac{1}{6}$ millimeter in diameter soon more or less buried by the exuding obovate-oblong, pale, olivaceous-black, 3-septate, 10–12 by 3–3½μ, sporules.

SEPTORIA LATHYRI, *n. s.* On dead leaves of *Lathyrus latifolious* (cult.), "Everlasting Pea," Newfield, N. J., March, 1889. Perithecia amphigenous, gregarious, prominent, mostly in groups, 2–4 millimeters

across; the leaf in these parts being slightly blackened. Sporules spiculiform, attenuated to a point at one end and subtruncate at the other, faintly nucleolate, 20–30 by $1\frac{1}{4}\mu$, mostly less than 25μ long. Differs from any of the four species on *Lathyrus* in the Sylloge in its shorter, spiculose sporules. *Septoria viciæ*, West, also has longer and thicker sporules. The general appearance is that of an erumpent *Sphærella*. Perhaps the spermogonia of *Sphærella lathyrina*, B. & C.

SEPTORIA INTERMEDIA, *n. s.* On *Solidago* (*juncea?*), Racine, Wis., June, 1888 (Davis No. 25). Spots small (1 millimeter), scattered, subconfluent dull-white, with a dark purple shaded border. Sporules nearly straight, hyaline, nucleolate 15–25 by $1–1\frac{1}{2}\mu$. Has the general appearance of *Septoria atropurpurea*, Pk., but is distinguished by its much shorter spores as well as different host.

SEPTORIA PHYSOSTEGIÆ, *n. s.* On leaves of *Physostegia Virginiana*, Racine, Wis., September, 1888. Dr. J. J. Davis, 4. Spots amphigenous, small (1 millimeter), dirty white, with a shaded purplish border. Sometimes several of the small white spots are included in a larger brown spot. Sporules filiform, nearly straight, 20–27 by $1–1\frac{1}{4}\mu$. *S. brunellæ*, Ell. & Holw. is on larger rusty brown spots and has longer sporules.

SEPTORIA ASTERICOLA, *n. s.* On *Aster cordifolius*, Magnolia, Mass. Miss Clarke; Delaware, Commons, 723 and 724; Wisconsin, Davis. Spots amphigenous, dark brown, subindefinitely limited, bounded by a broad yellow border, the brown central part 3–4 millimeters across. Perithecia innate, finally partially erumpent above, numerous, scattered, small (75μ), scarcely visible in the earlier stages of growth, light brown. Sporules slender, nearly straight, nucleate, 30–45 by $1–1\frac{1}{4}\mu$. Differs from *S. atropurpurea*, Pk. in its yellow bordered spots and shorter, narrower sporules.

SEPTORIA PRENANTHIS, *n. s.* On leaves of *Prenanthes*, Racine, Wis., August, 1888, Dr. J. J. Davis, 20. Spots scattered, suborbicular, dull white, with a purple border 2–3 millimeters in diameter, thin. Perithecia amphigenous, scattered on the spots, suberumpent, yellowish. Sporules filiform, slightly curved, continuous, 15–22 by $1–1\frac{1}{4}\mu$.

SEPTORIA ASCLEPIADICOLA. Jour. Mycol., IV, p. 44. The sporules are mostly only $1\frac{1}{2}\mu$ thick instead of $2–2\frac{1}{2}\mu$. The same thing has been sent from Missouri on *Asclepias rubra*, Demetrio, 215.

SEPTORIA COMMONSII, *n. s.* On leaves of *Cnicus altissimum*, Faulkland, Del., August, 1885. A. Commons, 137. Spots dark brown with a whitish center, round, 2–4 millimeters diameter, obscured below by the tomentum of the leaf. Perithecia epiphyllous, minute, clustered, black, subprominent. Sporules subspiculose, slightly curved, continuous, nucleolate, 25–40 by $1–1\frac{1}{4}\mu$. *S. cirsii*, Niessl., is said to have sporules 40–80 by $1\frac{1}{2}–2\mu$ and 8–12-septate. The specimens labeled *S. cirsii*, Niessl., in De Thümen's Austrian Fungi, 690, which are sterile, have the spots concentrically marked and have no white center.

SEPTORIA DEARNESSII, *n. s.* On *Archangelica atropurpurea*, London, Canada, August, 1889. Mr. J. Dearness, 552. Spots amphigenous, dark brown, irregular, angular, 1–5 millimeters in diameter. Perithecia innate, minute, slightly prominent, very obscure. Sporules issuing in white cirrhi, 15–22 by $1\frac{1}{2}\mu$, without nuclei or septa, nearly straight. Approaches *Cylindrosporium* on account of the imperfectly developed perithecia.

SEPTORIA DIVARICATA, *n. s.* On living leaves of *Phlox divaricata*, Lyndonville, N. Y., May, 1889. Dr. C. E. Fairman, 44. This is the *Septoria phlogis*, S. & S. ? in Journ. Mycol., III, p. 85. The Lyndonville specimens agree exactly with the Iowa specimens so that there is reason to think this is not an immature state of *S. phlogis*, S. & S., but a different thing. In fact it differs throughout from the description of that species. The spots are not white, only whitish, and the sporules instead of being 40–60 by $1–2\mu$ and 1–3-septate are 15–35 by 1μ, mostly $20–25\mu$ long, nearly straight instead of flexuous, and very faintly nucleolate but not septate.

SEPTORIA FAIRMANI, *n. s.* On living leaves of Hollyhock (*Althæa rosea*), Lyndonville, N. Y., June, 1889. Dr. C. E. Fairman, 77. Spots amphigenous, scattered, subangular, 3–4 millimeters in diameter, dark brown and limited in part by the veinlets, border narrow and dark. Perithecia epiphyllous, rather numerous, scattered quite evenly over the spots, black, $100–112\mu$, subprominent. Sporules filiform, slightly curved, nucleate, 30–45 by $1\frac{1}{2}–2\mu$, hyaline. Whether *S. althææ*, Thüm., is different from this it is impossible to tell, as the specimen in his Austrian Fungi, 955, is a *Cercospora*. He says of this (F. Aust., 955) "perithecia arranged in a circle on dry pale brown spots," which applies very well to his specimen. Apparently De Thümen mistook the tufts of *Cercospora* for perithecia. In Dr. Fairman's specimen the spots are dark brown. *S. lachastreana*, Sacc. & Let. has the sporules 3-septate, and the perithecia are smaller and on minute whitened spots. On the same leaves is a *Phyllosticta* with oblong 3–4 by $1\frac{1}{2}–2\mu$ sporules, on white deciduous spots of about the same size as those producing the *Septoria*. The *Phyllosticta* agrees with *P. althæina*, Sacc., only the sporules are smaller.

SEPTORIA CRYPTOTÆNIÆ, Ell. & Rau. ? J. M., III, p. 50. Specimens collected in Delaware by Mr. Commons (910) enable us to add the following notes: Spots white, becoming brown, angular, limited by the veinlets. Perithecia epiphyllous, erumpent, black, depressed-globose, $100–120\mu$, scarcely visible below. Sporules filiform, yellowish, attenuated towards each end, faintly nucleolate, slightly curved 20–30 by $1\frac{1}{4}–1\frac{1}{2}\mu$. The leaf turns yellow around the spots. Perithecia not abundant. This is closely allied to *S. ægopodina*, Sacc., which, however, has smaller perithecia. It is certainly very different from the specimen labeled *Septoria ægopodina*, Sacc. in Fungi Gallici, 1317. From *S. saniculæ*, E. & E. (J. M., IV, 44) it differs in its larger spots, perithecia, and sporules.

Septoria convolvuli, Desm. Prof. Hitchcock sends this from Iowa on *Calystegia sepium.* It is distinguished from *S. calystegiæ*, Desm. and *S. flagellaris*, E. & E. by its more numerous perithecia and larger spots, and from the latter also by its shorter (20–35μ) sporules.

Sphæronemella carnea, *n. s.* On ash bark, Lake Skaneateles, New York, July, 1872. Rev. J. L. Zabriskie, 119. Perithecia gregarious, erumpent, flesh-colored, subulate, 2 millimeters long, swollen at the base, which contains the sporigenous nucleus. Sporules oblong, hyaline, continuous, about 15 by 4μ, rounded at the ends.

Sphæronemella rosæ, *n. s.* On dead twigs and old calyx tubes of *Rosa lucida*, Newfield, N. J., June, 1889. Perithecia erumpent, membranaceous, ovate, yellowish, becoming black, about $\frac{1}{5}$ millimeter in diameter; narrowed above into a short, cylindrical, membranaceous, pale ostiolum, crowned with spherical yellow globule of exuded, narrow, elliptical, hyaline, continuous, $4\frac{1}{2}$–$5\frac{1}{2}$ by $2\frac{1}{2}$–3μ sporules. The perithecia are loosely bordered by the ruptured epidermis and white inside from the mass of sporules. This approaches *Cytispora*, but the perithecia are simple.

ASTERINULA nov. gen. of SPHÆROPSIDEÆ Fam. LEPTOSTROMACEÆ.

Perithecia dimidiate, scutelliform, submembranaceous, radiate-cellulose; sporules ovoid or oblong, 1-septate, hyaline. Differs from *Leptothyrium* in its uniseptate sporules, from *Asterina* in the absence of asci, and from *Ascochyta* in its superficial perithecia.

Asterinula Langloisii, *n. s.* On living leaves of *Magnolia grandiflora*, Louisiana, January, 1889. Rev. A. B. Langlois, 1656. Hypophyllous. Perithecia scattered or gregarious, not on any definite spots, dimidiate, superficial, radiate, cellulose, pierced above, 100–112μ in diameter mostly with a short fringe of brown mycelium around the margin. Sporules oblong or obovate-oblong 2-nucleate, becoming 1-septate, hyaline, 18–22 by 7–8μ, ends rounded and obtuse. Probably the spermogonial stage of some *Asterina.*

Diplodina ramulorum, *n. s.* On bleached stems of *Smilax* and *Lycium*, Newfield, N. J. Perithecia subcuticular, black, minute, gregarious. Sporules oblong, elliptical, smoky hyaline, 1-septate, 5–8 by 2–3μ.

Discula xanthoxyli, *n. s.* On dead stems of *Xanthoxylum*, St. Martinsville, La., January, 1889. Rev. A. B. Langlois, 1600. Perithecia gregarious, on bleached spots 2–3 centimeters long by $\frac{1}{2}$ centimeter broad, subdiscoid, about 150μ in diameter, of rather coarse cellular texture, with a small circular opening above. Immediately around this opening the perithecium is more compact and nearly opaque, but around this dark center it is thinner and translucent. Sporules abundant, oblong-cylindrical, hyaline, continuous, 12–20 by 3–$3\frac{1}{2}\mu$, arising directly from the cells of the proligerous layer, which are some-

times elongated and even imperfectly branched so as to form rudimentary basidia.

DISCULA RUNCINATA, *n. s.* On dead stems of *Stephanomeria runcinata*, Helena, Mont., January, 1889; Rev. F. D. Kelsey, 133. Gregarious or scattered, covered at first by the epidermis and then convex and closed, soon erumpent, and the upper part of the perithecia disappearing, leaving a broad opening above; of coarse cellular texture, 150–200μ in diameter. Sporules hyaline, continuous, oblong, curved, generally more strongly so at one end, 18–23 by $3\frac{1}{2}$–4μ. The sporules and the perithecia also are those of a *Vermicularia*, only the hairs or bristles are wanting.

DISCELLA PILOSULA, *n. s.* On a decorticated maple, Lyndonville, N. Y., April, 1889, Dr. C. E. Fairman. Perithecia gregarious, ovate $\frac{1}{3}$ to $\frac{1}{2}$ millimeter in diameter, erumpent, superficial, black, rough, and sparingly clothed with short, spreading, pale, glandular hairs intermixed with a few black bristle-like hairs, at first closed, then with a broad opening above, the margin sublacerate dentate or subfimbriate. Texture of the perithecia subfibrous. Sporules cylindrical, curved, 3–6-nucleate and either continuous or faintly 1-septate, brownish-hyaline, 10–16 by 2–$2\frac{1}{2}\mu$, the ends mostly abruptly mucronate-pointed and incurved. Basidia slender, simple, or sometimes branched, 25–30μ long. This would come better under *Amerosporium* but for the 1-septate sporules. The septum was only observed in the larger and more mature sporules and was then very faint, but there is no doubt of its presence, nor is it unlikely that after the specimens have lain in the herbarium a few years they may become three or more septate.

SPORONEMA PALLIDUM, *n. s.* On bleached spots on bare decaying wood of maple, Ridgeway, N. Y., May, 1889, Dr. C. E. Fairman, 58. Perithecia gregarious, erumpent, cespitose, $\frac{1}{2}$ millimeter in diameter, multiradiate-cleft above or after the laciniæ have disappeared, irregularly lacerate-cleft; at first closed. Sporules concatenate, 8–10 by 2μ, sub-cylindrical, hyaline, formed by constriction of the sporogenous filaments.

GLŒOSPORIUM REVOLUTUM, *n. s.* On living leaves of *Robinia pseudácacia*, Newfield, N. J., August, 1889. Mostly on leaves of the terminal shoots. The margin of the leaf becomes yellowish green and revolute, then brown and dead. The oblong 12–15 by 3–$4\frac{1}{2}\mu$ spores begin to ooze out from the buried acervuli as the affected part begins to turn brown, soon becoming confluent and forming a flesh-colored coating on the surface of the leaf. In the early stage of growth the fungus has the aspect of a *Taphrina*.

GLŒOSPORIUM CANADENSE, *n. s.* On living leaves of white oak, London, Canada, July, 1889; J. Dearness, 193. Spots amphigenous, irregular, subrotund, about $\frac{1}{2}$ centimeter in diameter, pale rusty brown in the center, with a broad dirty brown border and tolerably definite margin above, more indefinite below. Acervuli scattered, be-

coming dark, 180–200μ in diameter. Mostly erumpent above. Spores ovate-oblong, hyaline 10–14 by $3\frac{1}{2}$–$4\frac{1}{2}\mu$. Possibly not distinct from *G. umbrinellum*, B. & Br., but that is said to have the spots "minute."

Glœosporium hysterioides, *n. s.* On orange leaves, Florida, 1886; Dr. George Martin. Spots large, mostly marginal, yellowish at first, then cinereous, and finally dirty white, border yellow, broad, and slightly elevated. Acervuli erumpent, black hysteriiform. Spores oblong, 12–15 by $3\frac{1}{2}$–5μ, not curved, basidia shorter than the spores. Spots 1–2 centimeters across, often extending along the margin of the leaf. Differs from *G. sphærelloides*, Sacc., in its short basidia and from *G. hesperidearum* in its definite spots.

Glœosporium ramosum, *n. s.* On leaves and stems of *Polygala polygama*, Newfield, N. J., June, 1889. Parts of the leaf at first turn dark purple and on these discolored places appear small, circular yellowish-white spots about 1 millimeter in diameter. In these spots are seated the innate acervuli, generally only one at first in the center of the spot, finally 2–4, slightly prominent and black above, appearing like the erumpent apex of a small perithecium, but the oblong-cylindrical, slightly curved, obtusely pointed, granular, continuous, 12–22 by 3–$3\frac{1}{2}\mu$ spores, on thick branching basidia, about as long as the spores themselves, are discharged below. This differs from the other species of *Glœosporium* in its branched basidia which much resemble the spores themselves. The fungus is very destructive to the plants, all the leaves soon turning pale-yellowish and falling off.

Glœosporium (Marsonia) brunneum, *n. s.* On leaves of *Populus candicans*, Newfield, N. J., August, 1889. Leaf mottled above with small black spots which soon become confluent in large areas, especially around the margin, the entire lower surface of the leaf soon assuming a uniform bronze-brown color. Acervuli 1–3 in each of the minute black spots, pale, erumpent on both sides of the leaf, finally nearly black. Conidia clavate obpiriform, hyaline, 1-septate below the middle, 14–16 by 5–7μ. On account of the smaller conidia and different habit this seems sufficiently distinct from *G. populi* and *G. castagnei*. There are no well defined spots, only the small black specks soon confluent and blackening finally the greater part of the leaf.

Glœosporium (Marsonia) graminicolum, *n. s.* On living leaves of grasses, London, Canada, August, 1889. J. Dearness, 341. Spots amphigenous, black, subindefinite, 2–3 millimeters, becoming white in the center from the erumpent spores. Acervuli minute, buried, cirrhi white, minute. Spores cylindrical, 1-septate, 15–22 by 3–4μ hyaline. The leaf is slightly thickened at the spots.

Phleospora aceris, (Lib.). On leaves of *Acer dasycarpum*, Manhattan, Kans., July, 1887. W. T. Swingle. Dr. Winter has issued this in his Exsicc. (3480) under this name (see also N. A. F. Cent., XXIII). *Glœosporium acerinum*, Pass. in De Thümen's Mycotheca (93)

differs only in its rather shorter spores, which are also more distinctly thickened at one end. In both they are 3-septate.

GLŒOSPORIUM (SEPTOGLŒUM) AMPELOPSIDIS, *n. s.* On fading leaves of *Ampelopsis quinquefolia*, Racine, Wis., September, 1888, Dr. J. J. Davis, 69. Spots amphigenous, angular, limited by the veinlets of the leaf, 2–3 millimeters in diameter, greenish. Acervuli erumpent on both sides of the leaf, prominent. Spores clavate-cylindrical, 5–9-septate, 30–35 by 4–4½μ.

GLŒOSPORIUM LAGENARIUM, Pass. var. MUSARUM, E. & E. On banana rind, Lincoln, Nebr., Roscoe Pound, 23, does not differ essentially from the forms on various species of *Cucurbitaceæ.* A foliicolous form of this species has proved very destructive around Newfield, N. J., this year on water-melon and musk-melon vines.

CYLINDROSPORIUM? OCULATUM, *n. s.* On leaves of *Populus monilifera*, Put-in-Bay, Ohio, August, 1888, Dr. J. J. Davis, 14. Spots amphigenous, round, 3–5 millimeters in diameter, grayish white, with a darker margin and a narrow raised border. Acervuli innate, amphigenous, yellowish (finally blackish), rather large (⅕ millimeter). Spores clavate-cylindrical, curved, 30–50 by 3μ nucleate (becoming 3 or more septate).

CYLINDROSPORIUM CLEMATIDIS, E. & E. J. M. III, p. 22. Mr. Galloway sends some leaves of *Clematis Jackmanii* collected at Geneva, N. Y., June 20, 1889, in which the tubercular masses of exuded spores are *black*, but the spores themselves are hyaline as in the original specimen on *C. Virginiana.* In the Geneva specimen the spots are less distinct and definite, and the acervuli are not confined to the spots, thus differing considerably from the original description. It may, however, be doubted whether the specimens on *C. Jackmanii* are specifically distinct, and we have for the present at least placed them as a variety, *C. clematidis*, E. & E., var. *Jackmanii.*

CYLINDROSPORIUM VIRIDIS, *n. s.* On living leaves of *Fraxinus viridis*, St. Martinsville, La., May, 1889. Langlois, 1712. Spots (on the upper side of the leaf) numerous, dark purple, suborbicular, 3–4 millimeters in diameter, with a subindefinite margin and a small (1 millimeter or less) rusty-brown center. On the lower surface of the leaf the purple color is entirely wanting, only dirty brown 1–2 millimeter subindefinite spots opposite the center of those on the other side. Acervuli innate, 3–6, in or near the center of the spots, prominent below, but opening above and discharging snow white heaps of cylindrical fusoid, 30–35 by 2½μ, nucleate spores curved nearly to a semicircle. The measurement is from tip to tip as the spores lie curved. Readily distinguished from *C. fraxini*, E. & K., by the purple spots and shorter spores. What appears to be the same, but without fruit, has also been sent from Ohio (Morgan, 405).

CYLINDROSPORIUM SACCHARINUM, *n. s.* On living leaves of *Acer*

saccharinum, Racine, Wis., October, 1888. Dr. J. J. Davis, 59. Spots amphigenous, numerous, scattered, subangular, minute (mostly about 1 millimeter in diameter), greenish black, becoming darker. Acervuli hypophyllous, minute, crowded in the spots, black above, so as to resemble minute perithecia. Spores slender-cylindrical, more or less curved, hyaline, granular, becoming faintly 3-septate, 30–40 by $2\frac{1}{2}$–3μ erumpent in small white heaps which soon spread out into a small membranaceous patch like a minute white *Corticium*. This can not easily be mistaken for *Glœosporium aceris*, Cke. or *G. acerinum*, West.

HAINESIA BOREALIS, *n. s.* On *Galium boreale*, Haniloops, British Columbia, July, 1889. Dr. John Macoun, 156. Acervuli hypophyllous, scattered, suborbicular, erumpent, $\frac{1}{2}$ to $\frac{3}{4}$ millimeter in diameter, subgelatinous, yellowish-hyaline, depressed-hemispherical, with a narrow black linear margin formed from the ruptured epidermis of the leaf. Spores suballantoid, 5–7 by 1μ, faintly 2-nucleate, slightly curved, borne on fasciculate, more or less branched basidia, 20–25 by 1μ.

CRYPTOSPORIUM NUBILOSUM, *n. s.* On dead or partly dead leaves of *Carex* (*Pennsylvanica?*) Newfield, N. J., 1879. Sent also from Montana by Mr. Anderson (344) on an allied species of *Carex.* Acervuli innate, scarcely erumpent, black, 80–110μ in diameter, showing by translucence through the epidermis, gregarious in bands across the leaf or seriate. Sporules lunate-fusoid, 15–20 by $2\frac{1}{2}\mu$, *hyaline*, faintly nucleate.

NÆMASPORA MICROSPERMA, *n. s.* On bark of *Acer saccharinum*, London, Canada, August, 1889. J. Dearness, No. 562. Sporiferous cavities confluent for 1–2 centimeters between the laminæ of the bark, purplish-black, the minute, ovate, or elliptical 2–$2\frac{1}{2}$ by $1\frac{1}{2}$–2μ spores bursting out in copious cherry-red masses and cirrhi through cracks in the bark. Differs from *C. difformis*, Sz., in its smaller spores on basidia, 12–15 by $1\frac{1}{2}\mu$.

PESTALOZZIA AFFINIS, *n. s.* On fallen leaves of "Japan Chestnut," Lafayette, La. Acervuli innate, erumpent, on both sides of the leaf, but more abundant below. Spores acutely elliptical, pale, 15 by 5μ (about 12μ) between the extreme septa, 4-septate, with a single oblique bristle about 7μ long at the apex and borne on a pedicel shorter than the spore. The spores ooze out in small black heaps, which are as usual often subconfluent-diffused. This differs from *P. pallida*, E. & M., in its broader spores and in lacking the *prominent septa* of that species.

PESTALOZZIA FLAGELLIFERA, *n. s.* On branches of *Comptonia asplenifolia*, killed by fire a few weeks ago, Newfield, N. J, June 10, 1889. Pustules numerous, subcuticular, raising the epidermis into little tuberculiform pustules which become slightly ruptured above and have a dark gray nucleus. Spores abundant, oblong, slightly curved 1-septate, yellowish-hyaline, 9–12 by 3μ, on stout basidia, about as long as the spores with a single long (25–35μ) undulate, hyaline bristle ris-

ing from one side of the apex. The spores are mostly a little narrower below and more acute.

PESTALOZZIA AQUATICA, *n. s.* On living leaves of *Peltandra Virginica*, Newfield, N. J., August, 1889. Spots amphigenous, chestnut brown ½ to 1 centimeter in diameter, concentrically wrinkled, border narrow, darker, acervuli epiphyllous, erumpent, ¼ to ⅓ millimeter in diameter, black, convex, then concave. Spores obovate, 18–20 by 6–7μ, 4-septate, end cells hyaline, next to the lower cell subhyaline, two next above dark. Crest of three stout (15–20 by 1μ) hyaline spreading bristles. What appears to be the same is found also on leaves of *Sarracenia purpurea*.

PESTALOZZIA NERVALIS, *n. s.* On veinlets of living white-oak leaf from which the parenchyma had been eaten away by some larva, Racine, Wis., September, 1888. Dr. J. J. Davis, 3. Acervuli subhysteriiform. Conidia narrow, elliptical or broad, oblong-fusoid, 4-septate, terminal cells hyaline, colored part (3 inner cells) about 14 by 6μ, lower hyaline cell 8–9μ, long, oblique bristle at the apex 8–9μ long.

PESTALOZZIA MAURA, E. & E. J. M. IV, p. 123. Mr. Langlois finds this at St. Martinsville, La., on dead leaves of *Persea Carolinensis* and on leaves of *Quercus virens* and *Q. palustris*, differing from the Florida specimens only in the absence of any spots, the innate erumpent acervuli being scattered irregularly over the leaf and mostly erumpent below. This species is well characterized by its obconic conidia, having the two cells next below the upper hyaline cell almost black.

BLACK SPOT OF ASPARAGUS BERRIES.

By CHARLES E. FAIRMAN.

These berries are of some slight agricultural importance. Thus we read in the report of the U. S. Agricultural Department for 1885, p. 613, "To save seed the stalks should be cut when the former are scarlet and ripe, to be stripped by hand or thrashed off on a cloth or floor, then pounded in a wooden mortar with a wooden pestle to break the outer shells. The seeds are then frequently washed to float away the chaff, dried in the sun and air and stored."

Asparagus berries are liable to a disease which may, for brevity's sake, be called black spot.

This is due (*a*) to the growth of fungi in the interior of the berry, (*b*) to growth of fungi on the exterior of the berry.

(*a*) Some asparagus berries which had been gathered in September, 1886, were found, a month or two later, to show black spots in the interior. In the blackened substance of the berry, mycelial threads were frequently found, but fruiting specimens were rare. The black spots were thought to be due to chemical changes in the berry produced by fungi. The fungus which causes this is probably *Penicillium glaucum.* The determination was made according to the figure of this fungus given by Beale.*

The contents of the berry would seem to furnish a favorable medium for the growth of fungi. Reinsch, in 1870 (according to the National Dispensatory 1879, p. 249); found in the berries considerable grape sugar.

(*b*) External spotting of the berry is due to the growth of fungi on the surface. This was noticed in berries which remained on the stems some time after ripening. The stems are covered at times with a black incrustation which may extend to the berry and involve more or less of its surface. The most common cause of this is the growth of *Cladosporium.*

This brief note will have fully served its purpose if it calls attention to these growths and thus better fruited specimens (than I have as yet found) are secured. As is well known, the most common fungi on decaying vegetable matter are *Macrosporium* and *Cladosporium.* J. B. Ellis (in letter of January 28, 1887), has said:

> It is not improbable that with the proper degree of heat and moisture one or the other of these would make its appearance on the berries in the form of a velutinous or fine hair-like growth of fertile threads bearing the spores or conidia peculiar to one or the other of these genera.

At present nothing farther can with certainty be said.

AN EXPERIMENT IN PREVENTING THE INJURIES OF POTATO-ROT (*Phytophthora infestans.*)†

By CLARENCE M. WEED.

(1) The experiment reported by the author was undertaken to determine what effect the application of a solution of sulphate of copper and lime (known as the Bordeaux mixture) to the foliage of potatoes would have in preventing the injuries of the potato-rot, and was conducted on the grounds of the Ohio Agricultural Experiment Station.

(2) Fifteen feet at the end of each of twenty rows of potatoes were

* Microscope in Medicine, fourth edition, Fig. 7, Plate XXV.

† Summary of a paper read before the Society for the Promotion of Agricultural Science, August 27, 1889.

sprayed with the Bordeaux mixture four times, viz, May 28, June 6, June 29, and July 16. Four varieties were included in the experiment, viz, Early Ohio, Early Oxford, Puritan, and Lee's Favorite.

(3) The season proved favorable for the development of the blight, which appeared in the experimental field about the middle of June, and did serious damage for the next six weeks.

(4) The sprayed vines showed much less injury than their unsprayed companions, remaining green after the others were dead.

(5) The crop was harvested August 22, and the product of 12½ feet of the sprayed part of each row was compared with the product of an equal distance of the unsprayed portion of the same row. The results have been summarized as follows:

(*a*) From the treated portions of four rows of the Early Ohio variety, 536 potatoes, weighing 67 pounds 4 ounces, were obtained, of which 231 were of marketable size and weighed 48 pounds 6 ounces; while from the untreated portions of the same rows 496 potatoes weighing 50 pounds were obtained, 200 of which were marketable, and weighed 34 pounds 4 ounces. There was thus an increase in favor of the treated hills of 17 pounds 4 ounces total product, and 14 pounds 2 ounces marketable product.

(*b*) The treated portions of five rows of Early Oxford potatoes yielded a total of 622 tubers, weighing 87 pounds 1 ounce, of which 321, weighing 70 pounds 4 ounces, were marketable, while the untreated hills of the same rows yielded a total of 707 tubers, weighing 77 pounds 4 ounces, of which 267, weighing 53 pounds 2 ounces, were marketable. There was thus an increase in favor of treated hills of 9 pounds 13 ounces total product, 17 pounds 2 ounces marketable product.

(*c*) The treated portions of six rows of the Puritan variety yielded a total of 727 potatoes, weighing 93 pounds 6 ounces, 327 of which, weighing 70 pounds 4 ounces, were marketable, while the untreated portions of the same rows yielded 810 potatoes, weighing 83 pounds 12 ounces, of which 266, weighing 53 pounds 15 ounces, were of marketable size. There was thus an increase in favor of the treated hills of 9 pounds 10 ounces total, and 16 pounds 5 ounces marketable product.

(*d*) From the sprayed portions of five rows of Lee's Favorite potatoes, 584 tubers, weighing 72 pounds 12 ounces, were obtained, of which 249, weighing 55 pounds 4 ounces, were marketable; while the unsprayed portions of the same rows yielded 658 tubers, weighing 63 pounds 4 ounces, 175 of which were of marketable size, and weighed 38 pounds 12 ounces. Consequently, there was a difference in favor of the sprayed hills of 9 pounds 8 ounces total weight, and 16 pounds 8 ounces marketable weight.

(6) By combining the results given in paragraphs *a*, *b*, *c*, and *d*, we find that the treated portions of the twenty rows yielded a grand total of 2,471 potatoes, weighing 320 pounds 7 ounces, and that 1,128 of these were of marketable size, and weighed 244 pounds 2 ounces; while the

untreated portions of the same rows yielded a grand total of 2,771 potatoes, weighing 274 pounds 4 ounces, of which 948 were of marketable size and weighed 180 pounds 1 ounce. There was consequently a grand total increase in favor of the treated hills of 46 pounds 3 ounces total product, and 64 pounds 1 ounce marketable product.

(7) This 64 pounds 1 ounce increase in marketable product was obtained from 250 feet of row (20 times 12½). This represents an increase of 4.1 ounces to the foot. As there are 14,560 feet of row in an acre of potatoes as ordinarily planted, an increase of 4.1 ounces to the foot amounts to 59,696 ounces, or 3,731 pounds to the acre. Reducing this to bushels by dividing by 60 (the number of pounds to the bushel) we get an increase from the treatment of 62.2 bushels to the acre.

(8) There was in nearly every case a marked difference in the amount of scab on the treated and untreated tubers, the former being much more free from the disease.

CONCLUSIONS.

So far as a single experiment can be relied upon, the results here reported seem to indicate the correctness of the following provisional conclusions:

(1) That a large proportion of the injury done by the potato rot can be prevented by spraying the vines with the Bordeaux mixture.

(2) That this treatment apparently diminishes the amount of scab affecting the tubers.

(3) That by adding London purple to the mixture, the same treatment may be made effective in preventing the injuries of both the rot and Colorado Potato Beetle.

NEW EXSICCATI.

By D. G. Fairchild.

I. PARASITIC FUNGI OF CULTIVATED PLANTS.

The second fasicle of Messrs. Briosi & Cavara's Parasitic Fungi of Cultivated Plants* has been received. The fascicle contains many interesting things, the following of which are of special importance to this country:

Phytophthora infestans, (Mont.) DBy., on *Solanum lycopersicum.*
Plasmopara viticola, B. & C., on *Vitis vinifera.*
Uromyces trifolii, Wint., on *Trifolium pratense.*
Puccinia graminis, Pers., (I), on *Berberis vulgaris.*
Cercospora rosæcola, Pass., on *Rosa, (cult.).*
Coniothyrium diplodiella, (Speg.) Sacc., on *Vitis vinifera.*
Colletotrichium lindemuthianum, (S. & M.) B. & Cav., on *Phaseolus vulgaris.*

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* Funghi Parassiti Delle Piante Coltivate od Utili.

It will be seen that the following well-known diseases are represented: The downy mildew of the tomato and grape, the rust of clover and grass, leaf blight of the rose, white-rot of the grape, and anthracnose of the bean. The latter disease, as well as some of the others, have been quite fully illustrated and described in the reports of this Section. It is to be regretted that the descriptive part of this work is Italian; notwithstanding this, however, it seems to us that it would prove a valuable acquisition to the collection of every experiment station.

II. KELLERMAN & SWINGLE'S KANSAS FUNGI.

The second neatly prepared fascicle of the fungi of Kansas has lately appeared. The list of species and host plants is as follows:

ÆCIDIUM CALLIRRHOËS, E. & K., on *Callirrhoë involucrata.*
ÆCIDIUM GROSSULARIÆ, Schum., *Ribes aureum.*
ÆCIDIUM PENTSTEMONIS, Schw., *Pentstemon grandiflorus.*
ÆCIDIUM PUSTULATUM, Curt., *Comandra umbellata.*
ÆCIDIUM TUBERCULATUM, E. & K., *Callirrhoë involucrata.*
CÆOMA NITENS, Schw., *Rubus villosus.*
CERCOSPORA ALTHÆINA, Sacc., *Althæa rosea.*
CERCOSPORA DIANTHERÆ, E. & K., *Dianthera Americana.*
CERCOSPORA JUGLANDIS, Kell. & Sw., *Juglans nigra.*
CERCOSPORA POLYTÆNIÆ, E. & K., *Polytænia Nuttallii.*
CERCOSPORA TUBEROSA, E. & K., *Apios tuberosa.*
DENDRYPHIUM SUBSESSILE, E. & E., *Smilax hispida.*
ENTYLOMA PHYSALIDIS, (Klachbr. & Cke.) Wint., (*a*) *Physalis lanceolata;* (*b*) *Physalis pubescens.*
FUSICLADIUM EFFUSUM, Wint., *Carya amara.*
GLŒOSPORIUM NERVISEQUUM, (Fckl.) Sacc., *Platanus occidentalis.*
PERONOSPORA ANDROSACES, Niessl., *Androsace occidentalis.*
PHYLLOSTICTA IPOMŒÆ, E. & K., *Ipomœa pandurata.*
PUCCINIA NIGRESCENS, Peck., (*a*) *Salvia lanceolata:* (*b*) *Salvia azurea*, var. *grandiflora.*
PUCCINIA SCHEDONNARDI, Kell. & Sw., *Schedonnardus Texanus.*
PUCCINIA SILPHII, Schw., *Silphium integrifolium.*
RAMULARIA URTICÆ, Ces., *Urtica gracilis.*
SEPTORIA TENELLA, Cke. & Ell., *Festuca tenella.*
UROMYCES GRAMINICOLA, Burrill, *Panicum virgatum.*
UROMYCES HYALINUS, Peck., *Sophora sericea.*
UROMYCES POLYGONI, (Pers.) Fckl., (*a*) *Polygonum aviculare;* (*b*) *Polygonum ramosissimum*; leaves (*c*) *Polygonum ramosissimum*, stems.

III. SYDOW'S UREDINEÆ.

The following is a condensed list of the contents of Fascicle III of Sydow's exsiccati, designed to contain only species of the rust fungi, or order *Uredineæ.* Fascicles I and II were issued some time ago; each fascicle contains fifty specimens. The specimens are large and well mounted, and, with the exception of the written labels, the work is altogether a very satisfactory one:

Uromyces trifolii, (Hedw.) Wint., on *Trifolium hybridum.*
Uromyces limonii, (DC.) Wint., *Armeria vulgaris.*
Uromyces polygoni, (Pers.) Wint., *Polygonum aviculare.*
Uromyces geranii, (DC.) Wint., *Geranium molle.*
Uromyces striatus, Schrœt., *Trifolium arvense.*
Uromyces anthyllidis, (Grev.) Schrœt, *Anthyllis vulneraria.*
Uromyces erythronii, (DC.) Wint., *Fritillaria Meleagris.*
Uromyces erythronii, (DC.) Wint., Æcidium, *Erythronium denscanis.*
Uromyces ficariæ, (Schum.) Lév., *Ficaria verna.*
Uromyces scillarum, (Grev.) Wint., *Muscaria racemosum.*
Uromyces scillarum, (Grev.) Wint., *Scilla maritima.*
Puccinia galii, (Pers.) Wint., *Galium aparine.*
Puccinia calthæ, Link, *Caltha palustris.*
Puccinia cirsii-lanceolati, Schrœt., *Cirsium lanceolatum.*
Puccinia lampsanæ, (Schultz) Fckl., *Lampsana communis.*
Puccinia crepidis, Schrœt., *Crepis actorum.*
Puccinia violæ, (Schum.) Wint., *Viola hirta.*
Puccinia pimpinellæ, (Str.) Wint., *Pimpinella magna.*
Puccinia graminis, Pers., *Triticum repens.*
Puccinia coronata, Cd., *Glyceria spectabilis.*
Puccinia rubigo-vera, (DC.) Wint., *Bromus mollis.*
Puccinia rubigo-vera, (DC.) Wint., *Symphitum officinale.*
Puccinia poarum, Niel., *Poa nemoralis.*
Puccinia phalaridis, Plowr., *Degraphis arundinacea.*
Puccinia suaveolens, (Pers.) Wint., *Cirsium arvense.*
Puccinia hieracii, (Schum.) Schrœt, *Carlina vulgaris.*
Puccinia bullata, (Pers.) Wint., *Peucedanum cerraria.*
Puccinia falcariæ, (Pers.) Wint., *Falcaria Rivini.*
Puccinia falcariæ, (Pers.) Wint., Æcidium, *Falcaria Rivini.*
Puccinia anemones-virginianæ, Schw., *Anemone silvatica.*
Puccinia torquati, Pass, *Smyrnii olusatrum.*
Phragmidium sanguisorbæ, (DC.) Schrœt., *Sanguisorba minor.*
Phragmidium subcorticium, (Schrk.) Wint., *Rosa canina.*
Gymnosporangium clavariæforme, (Jacq.) Wint., Æcidium, *Cratægus oxyacantha.*
Melampsora helioscopiæ (Pers.) Wint., *Euphorbia esula.*
Melampsora vaccinii, (Alb. & Sch.) Wint., *Vaccinium vitis-idæa.*
Melampsora circææ, (Schum.) Wint., *Circæa lutetiana.*
Melampsora pyrolæ, (Gmel.) Schrœt., *Pyrola uniflora.*
Coleosporium senecionis, (Pers.) Wint., Æcidium, *Pinus austriaca.*
Coleosporium sonchi-arvensis, (Pers.) Wint., *Sonchus arvensis.*
Coleosporium campanulæ, (Pers.) Wint., *Campanula patula.*
Chrysomyxa sedi, (Alb. & Sch.) Wint., *Sedum palustre.*
Cæoma empetri, (Pers.) Wint., *Empetrum nigrum.*
Cæoma laricis, (Westd.) Wint., *Laris Europæa.*
Æcidium aquilegiæ, Pers., *Aquilegia vulgaris.*
Æcidium pedicularis, Sibosch, *Pedicularis palustris.*
Æcidium cressæ, DC., *Cressa cretica.*
Æcidium mespili, DC., *Mespilus Germanica.*
Æcidium mespili, DC., *Cratægus grandiflora.*
Puccinia hieracii, (Schum.) Schroth. *Taraxacum officinale.*

A METHOD FOR PRESERVING THE SPORES OF HYMENOMYCETES.*

By Dr. C. O. Harz.

In studying and making a collection of the *Hymenomycetes* the preservation of spore preparations on paper is everywhere enjoined.

Formerly I used a very simple method for colored spores. I allowed them to fall upon any convenient white paper, a process which required from one to two hours up to a half or an entire day, according to the object. After the removal of the fungus I allowed the spores to lie a short time in the air in order to become dry, when I spread a solution of Canada balsam in absolute alcohol, on the back side of the paper, taking care that the spore preparation should not be overflowed by a too copious amount of the fluid. In this manner the preservation or fixing of the spores is accomplished simply and quickly.

I met with difficulties in case of colorless spores, because it is always hard to obtain suitable, well-glazed colored paper whose coloring material is not soluble in alcohol.

Herpell attempted to remove the difficulty by the application of ether, mastix, etc., but I was not always successful in obtaining satisfactory preparations of white spores in this way.

I have successfully tested the following method for two years: Dissolve one part Canada balsam in four parts turpentine oil, warming them gently over a water bath or free flame. Spores of all colors, as well as colorless ones, can be quickly fixed upon any convenient white or colored paper with this solution.

For colored spores I take any smooth, wood-free, white writing paper, of different grades; for white, relatively colorless spores, any convenient glazed paper can be used. Blue and black are specially adapted to the purpose, but yellow, red, green, and other colors of glazed papers also furnish beautiful preparations.

The application of the above solution is very simple; it should be spread thinly on the back side of the paper on which the spores are scattered, with a soft brush, and should not be spread on so thickly as to overflow the spores. In from two to four days the preparations are so far dried out that they can be safely kept between papers. They become quite dry (that is, so that the finger will not rub them off) in four to six weeks.

In some cases this method required some minor corrections.

(1) If the spores have been shed in unusual abundance, it is a good plan to repeat the application once after one or two days, or prepare for this special purpose a solution of two parts Canada balsam in five or six parts of turpentine oil.

(2) If the so-called white spores fall very sparingly on the paper, I

* Translated from *Botanisches Centralblatt*, 1889, page 78, by E. A. Southworth.

use a solution of one part Canada balsam in from six to eight parts of turpentine oil.

It is perfectly self-evident that any other balsam soluble in turpentine oil, *i. e.*, turpentine, or a resin soluble in it, will answer the same purpose. Any other volatile oil can also be substituted for turpentine oil.

A DISEASE OF WHITE FIR.*

By Dr. Hartig.

A disease of the white fir, which caused very great injuries in the Bavarian woods, was discovered by the author, and shows itself in the dying of the bark of younger or older twigs and branches, often for over a hand's length. As a rule, the dying extends over the entire circumference of the twig, and in consequence the parts of the plants situated above this point die in a few years. Móre rarely the disease is confined to one side of the twig, and does not progress the second year, but an outgrowth occurs at the edge of the dead place. In the dead bark there develop numerous pycnidia, rarely larger than the head of a pin, which rupture the superimposed cork layer. Within the pycnidia arise numerous small, spindle-shaped gonidia, which germinate readily. Unfortunately, an acigerous fruiting form has not been found after several years of observations and cultures. To be sure *Peziza calycina* almost constantly produced a luxuriant formation of Apothecia in the immediate neighborhood, yet the absolute proof of its connection with the pycnidial form was impossible. Until it can be perfectly known the author has given this fungus the name *Phoma abietina, n. sp.*

NOTES.

By B. T. Galloway.

PREVENTION OF SMUT.

In the first number of The Journal† we gave a brief review of a paper published in the *Journal of the Royal Agricultural Society* of England by J. L Jensen on "The Propagation and Prevention of Smut in Oats and Barley." The interest shown in this paper has prompted us to publish a description of Mr. Jensen's method of treating the grain, and it is hoped that the suggestions made will enable the experiment stations to test the remedy. Mr. Jensen says:

> We have seen that smut can be prevented by dipping the grain in heated water. * * * The grain to be dipped is placed in a shallow cylindrical basket about 12 inches deep, lined with coarse canvas, and provided with a cover made by stretching the canvas over a ring of such a diameter as will pass inside the mouth of the basket.

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* Translated from *Botanisches Centralblatt* No. 3, p. 78, 1889, by E. A. Southworth.

† Page 42.

The canvas should overlap the ring by about an inch all round. An ordinary boiler, such as is found on every farm, is filled with water and heated to the boiling point.

Two vessels of sufficient size are placed near it. These may be designated 1 and 2. Supposing the boiler to contain 35 gallons of boiling water, if 12½ gallons of cold and the same quantity of boiling water be put into each vessel, we shall have 25 gallons of water at 132° F., in both of them. The exact temperature may be readily obtained by adding a little more hot or cold water, as the thermometer shows to be required.

A basket containing three-quarters of a bushel of grain, which must not be more than 8 inches in depth, is now dipped into No. 1 four times; this will take rather more than half a minute, and will reduce the temperature of the water 8 or 9 degrees. It is now to be rapidly dipped five or six times into No. 2, which will take about one minute, and then dip once per minute for three minutes longer, *i. e.*, five minutes altogether in the two vessels This will reduce the temperature of the water in No. 2 from 132° to 129° to 130°. If steeped barley be used the original temperature of the vessels should be 129° to 130°; but with unsteeped grain, for oats, wheat or rye, it does not matter if the original temperature be 133° to 136°.

The seed must now be cooled. This is best done by placing the basket on the top of a third vessel and pouring a couple of buckets of cold water upon the grain in it, taking care that the cold water falls not only upon the center, but round the edges, so that the corn may be uniformly cooled. The basket is now emptied on the floor and the seed spread out in a thin layer, so that it may cool completely. The water used in cooling the grain will have its temperature raised and may be employed in replenishing the boiler. The requisite temperature (132° F.) of vessels Nos. 1 and 2 must be maintained throughout the process by adding from time to time boiling water from the boiler and transferring from them a similar amount back again to the boiler. The temperature must be regulated by a thermometer, which when used must be plunged deeply into the water.

The basket must be completely immersed each time, then lifted quite out of the water so as to allow it to drain for four or five seconds before it is dipped again.

The above process in practice will be found simple and easy enough to perform, although its description is necessarily somewhat complicated.

REVIEWS OF RECENT LITERATURE.

ARTHUR, J. C. *Smut of Wheat and Oats.* Bulletin of the Agricultural Experiment Station of Indiana, No. 28, September, 1889.

While containing little or nothing new, this little bulletin is full of practical matter and will be an invaluable aid to those whose crops are attacked by these diseases.

Most of the bulletin is taken up with *Tilletia fœtens*, or "stinking smut," as Professor Arthur calls it, to distinguish it from black smut.

The fungus is described, and some space is devoted to early opinions as to the origin of smut. In the discussion of the name the author says that the name *Tilletia lævis* should be changed to *T. fœtens*, Rav., since Ravenel was the first to describe and name it.

Under the heading "attack and spread of the disease" the following questions are proposed and answered: "Will the smut spread from field to field while the crop is growing, as rust does? Will there be any danger of introducing it on one's farm by sowing seed wheat from a farm known to be smutted? Can the disease be introduced by the ap-

plication of manure from a farm where it has already gained a foot-hold? When it once gets into the soil will it persist as milk-weed, quack-grass, and Canada thistle do?"

The answer to the first question depends upon when and where the germinating spore enters the wheat plant. It has been pretty well settled that the plant is infected at the time of germination, and the germ tube enters near where the plantlet is attached to the grain. The practical application of this fact is that grains covered with soil can only receive infection from spores that were sown with the seed or already existed in the soil, but that smut will not spread during the growing season from field to field or from plant to plant.

The answer to the second question is a logical sequence of the preceding. If a crop has any portion smutted it is more than probable that the spores of smut will get in contact with the sound wheat kernels. One crushed kernel thoroughly distributed through a bin of seed wheat may result in many dollars' loss when the crop is harvested. Other sources of contamination are also given, viz: The thrasher having previously been used for smutted wheat; being stored in a bin or passed through a fanning-mill or seeder not properly cleansed after being used for smutted wheat; by using sacks that have not been disinfected.

The third question is answered in the affirmative. It has been shown that corn smut can pass through animals and retain its germinating power, and the same is likely true of wheat smut.

Spores retain their power of germination when dry for two or three or even more years, but in the field we may safely assume that two years will eliminate every trace of it.

Natural checks to its increase are ably discussed; they are, mainly, probability that the spores may not be near enough to the germ end of the kernel, insufficient moisture, and resistant varieties.

The nature of the injury is of a more comprehensive nature than is generally supposed. A definite percentage of the crop is actually lost. An extra amount of cleaning and screening is required for what is good. The wheat is unfit for seed until disinfected. The smut gives the flour a dark color and disagreeable smell. The straw and screenings are liable to spread the disease when converted into manure.

Under the heading "remedies and precautions" the author says that the prevention of smut costs not a fraction of the trouble or expense that is necessary in removing the Colorado beetle from potato-vines. The method of disinfection preferred is a soaking of the seed in a solution of blue vitriol, and several methods for doing it are given in full. The methods of prevention are very emphatically summed up as follows: "Clean seed upon a clean field will result in a clean crop."

Very little space is given to the black smut; its general appearance, habits, and botanical characters are described. The same method of treatment as that described for stinking smut is recommended for this

except that, on account of the hulls, oats and barley should be soaked longer.—E. A. SOUTHWORTH.

BOLLEY, HENRY L. *The Heterœcismal Pucciniæ.* American Monthly Microscopical Journal, Vol. X, 1889.

The author of this paper starts with a general account of the biology and classification of the *Uredineæ*, gives a short description of the internal arrangement of the order, as well as its position among the fungi, and a definition of *heterœcism*, ascribing as a cause "inherent wants of the parasite not to be satisfied by one of its hosts alone," rather than to any difficulty which the promycelia might find to an entrance into the host tissue. Taking up the mycelium, a short description is given, with a belief that there are no true haustoria, but that young mycelial threads, penetrating the cell walls, give the misleading appearance. The article treats of æcidia and spermogonia at some length, without, however, attempting to clear up the mystery of their designed use. Under the account of the teleutospore, a doubt is expressed in regard to the existence of the so-called germ-pores. The author finds in the process of germination, instead of the passage of a germ-tube through a previously formed canal, a gradual erosion of the endospore from within. In regard to the question of sexual or non-sexual reproduction in the order, the work of Dr. George Massee is criticised, claim being made that the stroma, which bears ultimately the æcidial spores, does not consist, as figured by the latter, of a stalked body, but of a mass of interlaced hyphæ—branches and extensions of ordinary hyphæ. In the cases studied by Mr. Bolley *Æ. berberidis* and *Æ. hepaticarum*, the basidia arise as bud-like branches from individual hyphæ without any characteristics of a sexual process, and the author coincides with H. Marshall Ward in the thought that this process has disappeared, not being longer needed by the fungus.—D. G. FAIRCHILD.

FARLOW, W. G. *Notes on Fungi.* Botanical Gazette, August, 1889.

In the last number of the *Botanical Gazette* Dr. Farlow gives an account of a *Cystopus* causing peculiar swellings on the stems of *Ipomœa pandurata*, sent him by Prof. L. H. Pammel from Missouri. It appears from the note that the form of *Cystopus* upon the *Convolvulaceæ* of the United States has hitherto been found wanting in oospores, raising the question whether or not it should be united under *C. cubicus* (Strauss), Lév., which inhabits the *Compositæ*. The specimens sent by Professor Pammel seem to have abounded in peculiar oospores. The oogonia also differed from those of others of the same genus, in having their walls raised in blunt papillæ or short flexuous ridges over the whole surface. Differing as it does in oogonia and oospores from *C. cubicus*, the author thinks it clearly can not be placed under it. The name *C. convolvulacearum*, Otth, used by Kellerman and Ellis, is considered, after correspondence with Dr. Fischer, of Berne, as only a manuscript name used by

Otth and first published by Zalewski, in 1883; which latter authority for *C. convolvulacearum* is consequently preferred, but the author considers the Schweinitzian name *Æcidium ipomææ-panduranæ*, given in 1822, as the first name applied to the form on *Convolvulaceæ* in North America.

Mention is made in the same paper of a very interesting *Peronospora*, found to agree with *P. Cubensis*, B. & C., which has been found independently in Cuba, Japan, and New Jersey, in which latter place it has attacked most vigorously the cucumber vines. It is especially interesting biologically as an exception to the general rule that only small conidial spores produce zoospores.—D. G. FAIRCHILD.

CAVARA, DR. F. *Materiaux de Mycologie Lombarde*, Revue Mycologique, October, 1889.

The author gives a list of the fungi of Lombardy, the following orders being represented: *Myxomycetes*, 4; *Zygomycetes*, 4; *Oomycetes*, 12; *Ustilagineæ*, 4; *Uredineæ*, 11; *Discomycetes*, 12; *Pyrenomycetes*, 33; *Hyphomycetes*, 44; *Sphæropsideæ*, 41; *Leptostromaceæ*, 4; *Melaneoneæ*, 13; Imperfect forms, 3. Fifteen of the species are new and are fully described and illustrated by two plates. There are also many interesting notes on some of the injurious species.—B. T. GALLOWAY.

FULTON, T. WEMYSS. *The Dispersion of the Spores of Fungi by the Agency of Insects, with Special Reference to the Phalloidei.* Annals of Botany, May, 1889, p. 207.

This interesting article may be divided into two rather distinct parts, the first comprising the results of Mr. Fulton's experiments with *Phallus impudicus*, and the second containing data gathered from different sources to prove that the adaptation of fungi for the visitation of insects is quite general among certain families.

After a description of the structure and development of the common Stinkhorn (*Phallus impudicus*), attention is drawn to the fact, noticed previous to 1575, that the liquefied hymenium, or stinking slime, of this species has great attractions for insects, especially two species of fly, *Musca vomitoria* and *Musca Cæsar*. To settle two important questions suggested by these insects feeding upon the slime filled with the ripe spores of the fungus, the effect of the slime upon the fly and the effect of the fly upon the spores, the author conducted two series of experiments. The first series, involving the first question, proved, as might be expected, that the slime has no effect upon the fly either before or after death. The second series, consisting in an attempt to produce the fungus from spores which had traversed the digestive organs of the fly, was measurably successful, although slightly incomplete, from the fact that only two out of four trials produced the characteristic mycelium, and of these, the one given an opportunity to develop its compound sporophore failed to do it. The author does not mention in his account of the experiment any attempt to free the excrement from

spores which might have been shaken from the feet and proboscides of the flies and have not traversed the digestive canal. From the connection it might naturally be supposed that no attempts were made.

Turning from a determination of the fact experimentally, the author, first making the statement that "it seems very probable that most all of those fungi whose spores are ultimately contained in a slimy or liquid substance of dark color, especially if of a fetid odor, and which is freely accessible, will be found to have their spores largely transported by the agency of insects," takes up the British *Coprini*, pointing out the superficial resemblance of their sporophores to the compound flowers of certain *Compositæ* and calling attention to the fact, in connection, that flies are alike the principal visitors of the flower and the fungus.

The *Phalloidei*, which to the author present the most striking adaptations to insect visitations, occupy considerable space in the paper, short tabulated descriptions—color, odor, habitat, and dimensions—of 59 species being contained. The summary from these descriptive tables shows that the color of the receptacle during the deliquescence of the hymenium in more than half of the species is some tint of red, and in the remainder, white; these colors occurring in 91 per cent. of the 59 species. Table IV gives the colors of more than a thousand species of fungi, other than *Phalloidei*, and reveals the fact that while 91.5 per cent. of the latter are either red or white, only 20.1 per cent. of other fungi are so colored, the great majority being brown, slate, or black—colors scarcely represented in the former group. The bearing of these data upon the author's inference that the brilliant tints of the *Phalloidei* have been developed to render them conspicuous is quite pointed, and when taken in connection with his last table—which is a comparison of 4,197 species of flowers with 59 *Phalloidei* and 1,288 other fungi —becomes doubly so. Table V shows that while only 73 per cent. of flowers and 24.7 per cent. of other fungi are white, red, or yellow—colors found by experiment to be the most conspicuous in wooded localities where fleshy fungi grow—96.6 per cent. of the *Phalloidei* are so colored.

In regard to the odor, determined in the case of 25 species, 76 per cent. were fetid. When this proportion is compared with that of odorous to inodorous flowers—9.9 per cent. determined from 4,189 species—and taken in connection with the numerous facts just mentioned, the author is warranted in concluding that "in the *Phalloidei* it can scarcely be doubted that we have a group of fungi which have undergone great modifications so as to become adapted for the dispersion of their spores by the agency of insects."—D. G. Fairchild.

Girard, Alfred. *Entomogenous Fungi.* Bulletin Scientifique de la France et de la Belgique. January–April, 1889.

This number contains three valuable and practical articles on Entomogenous fungi. The first, entitled (*Sorosporella agrotidis*, nov. gen.

et sp.) "A New Parasite of the Caterpillar of the Sugar Beet," is translated by A. Girard from a German article by N. Sorokin.*

The "gray worm" (Caterpillar of *Agrotis segetum*) is, he says, very troublesome in the southern provinces of Russia, and, judging from previous experiences with the wheat aphis, he thinks it possible to fight the enemy effectually by means of entomogenous fungi; but it is of the greatest importance that each farmer should know beforehand the amount of fungous powder (powder containing the spores of the fungus employed) required to infect a given area. To this end Professor Cienkowski has calculated the number of spores contained in a square millimeter and then in a cubic foot. Professor de la Rue has also estimated how much pure spore powder it requires to cover a given area with a layer of spores .008 of a millimeter thick (twice the thickness of a spore). This calculation is supplemented by Professor Saikewitsch, who has determined that the interstices of a given amount of earth will take up one half its volume in pure spores, so that if impure powder is used twice as much will be required as of the pure.

The author placed several diseased "gray worms" in a box, where they soon died, and on examining them he decided that they were infested by a hitherto undescribed fungus to which he gave the name *Sorosporella agrotidis*. It is with this fungus that he hopes to be able to conquer the *Agrotis*.

The second article is a review of the preceding by the editor and translator, Alfred Girard.

He has compared Sorokin's description with Krassilstschik's description of *Tarichium uvella*, also a parasite of *Agrotis segetum* found in Southern Russia, and considers that the two fungi are probably identical. The name, he says, should be *Sorosporella uvella*, as the *T. uvella* of *Krassilstschik* can not be considered an *Entomophthora*, but is more closely related to the genus *Massospora*, Pk.

Northern France is, he says, as subject to attacks from the "gray worm" as Southern Russia, and the most chimerical remedies have been used to fight the scourge. In France he has often met a parasite of the "gray worm," *Entomophthora megasperma*, Cohn., which was of great aid in stopping the ravages of the *Agrotis* in 1867.

Unfortunately, however, only the *Tarichium* form—that is the resting spores—is to be found either in France or Germany, and all attempts at infection with it have failed. These resting spores may, however, develop and produce conidia in certain culture media. The best one for *Entomophthora calliphoræ* being the excrements of a batrachian.

From an incomplete experiment of Krassilstschik it would seem that under certain conditions *E. megasperma* develops the conidial form on the caterpillars of *Agrotis*, and the author suggests that this result might be regularly obtained by keeping the "gray worms" under glass, just

* Published in the *Centralblatt für Bakteriologie und Parasitenkunde*, 1888, IV. Bd. n. 21, pp. 644–647.

as the parthenogenetic generations of aphides can be indefinitely multiplied by keeping them in a continual summer environment. These suggestions are given to indicate the proper line of experiments to be followed out in fixing upon some plan for exterminating the "gray worm" in countries where it is injurious; and the paper closes with the remark that it is time to start in France an entomological department like the one now in operation in the United States.

The third article is another review by A. Girard, this time of a Russian paper, by Krassilstschik, bearing the Latin title: "*De insectorum morbis qui fungis parasitis efficiuntur.*" Much of the article consists of a critical analysis of Krassilstschik's work, and those parts will be omitted. In this review I shall only touch upon the points which have a bearing on the subject in question, and what follows will mainly consist of very free translations of portions of Girard's paper.

On the practical side of the question Krassilstschik seems to have obtained very remarkable results. Artificial cultures of the conidial form (*Isaria*) of certain *Pyrenomycetes* appear to have been made as easily as those of yeast or *Schizomycetes*. This success is very encouraging, and should impel us to take up new experiments on the *Entomophthoreæ*, which, up to the present, have resisted every attempt to cultivate them in lifeless media. Thaxter's researches have shown that some *Entomophthoreæ* are less exclusive in their choice of a host than was formerly supposed.

If Thaxter's experiments are verified, can not we cultivate *E. grylli* on the caterpillars of *Arctia*, which are so common and easy to raise, and use the spores so produced to infect the *Acrideæ* and arrest their ravages?

The observation of an *Entomophthoreæ* parasite on *Cecidomya destructor*, Say, is of very great interest. *Cecidomya destructor* is one of the most injurious insects, and it would be very important to be able to effectually combat it Krassilstschik has met this fungus both in the *Tarichium* and conidial state. He has also discovered an *Entomophthora* on the caterpillar of the nocturnal *Agrotis segetum*, which, in the vicinity of Odessa, especially attacks the rye. This is a very interesting fact, he observes, for Cohn has found a *Tarichium* on the same caterpillar without ever having met any conidia. In northern France I have met only the *Tarichium* form of the *Entomophthora* of the *Agrotis*, but a few mummified caterpillars which I placed in a moist chamber at a somewhat elevated temperature became covered with a whitish down analogous to the conidial stage of the *Entomophthoreæ;* unfortunately the observation was interrupted and I was unable to demonstrate the presence of conidia.

The discovery of *Botrytis Bassiana*, Bals. on two new hosts (*Musca domestica* and *Athalia berberidis ?*) made by Kowalevsky in the neighborhood of Odessa deserves special note. We know that Metschnikoff has already observed the white muscardine on *Anisoplia.* Krassilstschik

has found the same parasite upon *Cleonus punctiventris*, Germ. The insects that are so formidable to beet growers of southern Russia may then be effectually combatted by three fungi; the green muscardine (*Isaria destructor*, Metsch.), the red muscardine (*Sorosporella uvella*, Krassil.), and the white muscardine (*Botrytis Bassiana*, Bals.).

Vendhalm and Krassilstschik have also discovered a new species of *Isaria* upon an undetermined *Lixus* (larva and nymph), an *Isaria* that can undoubtedly be utilized in ridding ourselves of the different Curculios that attack the *Carduaceæ.*

But the fungus which Krassilstschik has most thoroughly studied is one which he has met on the eggs of the migratory locust (*Pachytylus migratorius*). This is a conidial form which Krassilstschik believes belongs to the *Isaria* of *Cordyceps ophioglossoïdes*, Ehr. & Tul.; this is also, it seems, the opinion of Professors Cienkowsky and Reinhardt, who have seen his preparations of the fungus.

If the *Isaria* on locust eggs is really *Isaria ophioglossoïdes* we find ourselves in the presence of a very curious fact.

The locust eggs evidently do not supply the fungus with sufficient nutriment for the development of the highest order of reproductive organs—the asci. But how does it happen that in certain localities *Cordyceps ophioglossoïdes* abandons the eggs of the *Acrideæ* to develop further on *Elaphomyces?*

The *Elaphomyces* are subject to invasions of numerous parasites and in particular of the dipterous larvæ of the genus *Helomyza.* Now the *Diptera* of this group are in turn often infested by entomogenous *Sphæriaceæ.* It seems to me very probable that the *Cordyceps* parasitic on *Elaphomyces* lived at first in the *Isaria* stage upon the larvæ of the *Diptera* which infested them, and from there extended their mycelium to *Elaphomyces* itself, where, thanks to more abundant nutriment, they could produce their asci. It is even possible that this might have occurred during the phylogenetic evolution, and that at present *Torrubia ophioglossoïdes* and *capitata* attack *Elaphomyces* directly.

The article concludes with the following direct translation (into French) from Krassilstschik's paper.

Although De Bary is lately inclined to accept Tulasne's view that *Isaria* is only the conidial form of *Cordyceps*, and considers it very probable that *Isaria farinosa* belongs to the cycle of development of *Cordyceps militaris*, it is necessary to observe that the genus *Isaria* comprehends an enormous number of forms; and since the union of this genus with that of *Cordyceps* is probable only for one species, it is useful for the time to retain the genus *Isaria* and to designate each form by a special name.

As to *Botrytis Bassiana*, De Bary as well as Brefeld formerly considered it as the conidial form of a Pyrenomycete (*Melanospora parasitica*); he appears, however, to have given up the idea after numerous cultures and experiments.

The genus *Stilbum* has but a few victims and one representative among muscardine fungi. This one is *Stilbum Buqueti.* Although this fungus is not perfectly well known, and for that reason we can scarcely expect to know whether it passes all its stages on insects, still, according to Buquet, the fungus develops only on dead insects ; and, judging from Robin's descriptions and excellent drawings, we must accept his view that *Stilbum* develops while the insect is living, completing its development after the death of the same; in a word, it behaves like a true muscardine.

In regard to *Tarichium* I have already said that this genus ought to follow *Entomophthora.* The difficulty of making artificial cultures of *Tarichium* and the impossibility of the artificial infection of insects with the spores of this fungus render the study of this group of organisms extremely interesting.

In the fungi noted on our list as accidentally developing on insects and possessing an entomogenous function, is one representative of the genus *Cladosporium.* Although the majority of the species of this genus are known as parasitic on plants, and *Cladosporium* does not exhibit parasitic qualities in the animal kingdom, it is necessary to call attention to the one case of this kind supported by a mycologist as experienced and learned as Professor Salensky, of Kazan. It may seem a little strange at first thought that a parasite as useful as *Cladosporium parasitium*, Sorok., which lives upon *Polyphylla fullo*, can be in a given case understood as only an accidentally saprophytic fungus.

It is useless to speak of *Penicillium* as entomogenous. *Penicillium glaucum*, which, in the opinion of Lohde, may be parasitic on a butterfly, *Bryophila raptricula*, can in no sense be reckoned among the entomogenous fungi; and if *Penicillium glaucum* does develop on dead chrysalides that are really attacked with muscardine it is simply as an after effect and a saprophyte. There is no doubt that the chrysalides of which Lohde speaks were already affected by another parasitic fungus before *Penicillium glaucum* developed.

The yeast fungi have nothing in common with the muscardines, and if formerly it was possible to believe, as Bail did, that the house-fly was killed by a yeast fungus, we know now, after the excellent researches of Brefeld, that the supposed yeast is only an *Entomophthora* in a certain stage of development. * * *

It is still necessary to mention the genus *Metarhizium* of which there are also certain representatives on our list. This new genus was established by Prof. N. Sorokin for the green muscardine, discovered by Metschnikoff upon the larvæ of *Anisoplia austriaca*, and called by him *Entomophthora anisopliæ.* As the characteristics of this fungus do not perfectly agree with those of *Entomophthora*, Professor Sorokin proposed to call it *Metarhizium.* But as Metschnikoff has since given the green muscardine the name of *Isaria destructor*, and as my long observations upon this fungus and a large number of pure cultures have proved to

me that the fungus of the green muscardine approaches in every respect the genus *Isaria*, the name *Metarhizium* became useless, the more so because the other representatives of this genus were imperfectly established. The fungus of the green muscardine has, besides, the typical aspect of an arborescent *Isaria* upon the larvæ of *Cleonus punctiventris* when placed in moist sand. In artificial cultures *Isaria destructor* is known besides under the form *Coremium.*

The ingenious names which Lebert has given to different forms of entomogenous fungi, such as *Verticillium*, *Polistophthora*, *Acanthomyces*, etc., by no means represent new forms but are only synonyms for *Cordyceps* and *Isaria.*

It remains to be seen in how many cases muscardine parasites of insects can develop under artificial conditions. It is said that experiments were made upon twenty-four different species of insects and always gave favorable results. Besides these, there were four other cases of contagion, which, although observed under artificial conditions (not in open air), did not arise from spores sown intentionally.

In these latter cases the parasite developed upon insects inclosed in bottles or boxes. It is interesting to note that in almost every case artificial infections are due to fungi of the genera *Isaria* and *Botrytis;* that is to say, to fungi whose artificial cultures succeed marvelously.

On the contrary, infections with the genera *Cordyceps* and *Entomophthora* are more restricted in number. Up to the present time artificial cultures of these genera have not succeeded at all. For the genus *Cordyceps* we have but one experiment by De Bary and for *Entomophthora* three experiments by Brefeld. No experiments have been attempted with *Stilbum*, but judging from the structure of the fungus, so like that of *Isaria*, it appears probable that artificial cultures and infections will succeed as well with it as with *Isaria*. With *Tarichium* all attempts of contagion have failed completely, and consequently artificial culture is shown to be impossible.

If later researches confirm the cycle of development of *Tarichium uvella*, and if the complete development of other representatives of this genus can be obtained in artificial cultures, it will then be possible to attempt infection with spores artificially produced. As has been indicated, the ordinary spores of *Tarichium* will never produce contagion when placed in contact with the bodies of insects.—EFFIE A. SOUTHWORTH.

HARTIG, Dr. ROBERT. *Lehrbuch der Baumkrankheiten.* Zweite verbesserte und vermehrte Auflage. Mit 137 Text-Abbildungen und einer Tafel in Farbendruck. Berlin. Verlag von Julius Springer, 1889. 8vo, cloth, pp. 291.

The second edition of Dr. Hartig's *Lehrbuch* embodies much interesting information in a convenient form and can not fail to meet with the same favorable reception as the first edition published in 1882.

Only one lithographic table has been introduced and an effort has been made to simplify the text as much as possible. What is here omitted the specialist will find in original papers, which in any event he would desire to consult, and the general reader will welcome the clear style and freedom from technical description. The individuality of the author is visible everywhere. He has copied no one, not even in the matter of wood-cuts and the result is an exceedingly interesting and useful book.

The introduction discusses briefly:

(1) The development of the doctrine of plant diseases (commencing with Schreger, 1795); (2) Causes of disease; (3) Methods of investigation.

The body of the work is divided into four sections: (1) Injuries by plants; (2) wounds, *i. e.*, mechanical injuries; (3) sickenings through influence of the soil; (4) sickenings through atmospheric influences. The first section contains 175 pages, the greater part of which is devoted to parasitic fungi. The treatment of this subject is somewhat broader than the title of the book would indicate, brief mention being made of diseases attacking grains, vegetables, and other herbaceous plants.

The author is most at home upon the wood-infesting and tree-destroying species, to which he has devoted many years of profound and painstaking inquiry. The following *Hymenomycetes* are described as destructive to living wood: *Trametes radiciperda*, *T. pini*; *Polyporus fulvus*, *P. borealis*, *P. vaporarius*, *P. mollis*, *P. sulphureus*, *P. igniarius*, *P. dryadeus*; *Hydnum diversidens*; *Telephora Perdix*; *Stereum hirsutum*, and *Agaricus melleus*. Mention is also made of *Polyporus fomentarius*, *P. betulinus*, *P. lævigatus*, and *P. Schweinitzii*, and the author believes that numerous other *Polypori* not yet critically investigated live as parasites in the wood of trees. *Dædalea quercina* and *Fistulina hepatica* are also probably parasitic, at least the former.

The destruction of timber receives considerable attention. There is a "dry rot" due to various fungi, the spores of which often find their way into cracks on the surface of logs while lying in the forest. These spores germinate the following summer while the logs are at the mill, if the heat and moisture are sufficient. The first symptom is a red-striping of the timber. The loss from this cause in the Bavarian forest is stated to be 33 per cent. of the entire product. The most vexatious timber-destroyer appears, however, to be the house fungus *Merulius lacrymans*. This attacks and destroys low lying or damp portions of buildings, and is peculiarly a plant associated with men, although it sometimes occurs in the forest. The extremely minute spores, about four million of which could be packed in the space of a cubic millimeter, germinate only in presence of some alkali, and this is thought to be the explanation of the fact that the fungus is most likely to appear in parts of buildings wet by urine, ashes, etc. When fresh, this fungus

has a very agreeable smell and a fine taste, afterward somewhat astringent. The mycelium excretes large quantities of water and keeps dwelling rooms excessively damp. In decay, the sporophores produce a very characteristic disagreeable odor, which is undoubtedly prejudicial to health. Infection may take place either through mycelium or spores. The latter are often carried from place to place on clothing, tools, etc., which have been used by workmen, especially carpenters, in repairing decayed buildings.

The book seems to have been very carefully prepared, but some omissions are noteworthy, and occasionally one meets a questionable statement.

Under *Gymnosporangium* four species are mentioned—*G. conicum* (*juniperinum*), *clavariæforme*, *Sabinæ* (*fuscum*), and *tremelloides*. The author thinks a further investigation of the forms thus far known and described is desirable, as the results of some experiments instituted by him do not agree with those commonly accepted. No mention is made of the labors of Dr. Farlow or of Dr. Thaxter.

Under bacteria Dr. Hartig urges the commonly accepted view that the acid reaction of most plants is unfavorable to their growth and development, and evidently thinks they play a very unimportant rôle in the production of plant diseases. They have been found as parasites, he says, only in thin-walled, soft parenchymatous tissue, such as bulbs and tubers, and here are often preceded by fungi. Even in Waacker's hyacinth disease (the yellow, slimy bacteriosis) "the bacteria do not attack entirely sound, well-ripened bulbs under normal conditions," but only those that have been wounded or previously attacked by fungi, especially by a hyphomycetous fungus, which is almost always associated with this bacteriosis. In damp places the bacteria enter the wounds and cause the rot. The following paragraph on pear blight will hardly pass muster, and was certainly not to be expected in a handbook published in 1889. All the recent American publications on this subject, especially the papers by Dr. Arthur, appear to have escaped the author's attention.

> Recently a disease of pear and apple trees, called blight, has been described by J. Burrill in Urbana, Ill., the cause of which this investigator ascribes to the invasion of a bacterium. The disease appears to bear a resemblance to the tree canker (*Baumkrebs*) caused by *Nectria ditissima*, and since in this fungus small bacteria-like gonidia are produced in great numbers in the bark, it becomes necessary to inquire first of all whether this disease has not been wrongly ascribed to a schizomycete.

Mention is made of fifteen species of *Exoascus*, all of which produce characteristic hypertrophies. Seven of these species also cause *hexenbesen* or witchbrooms, and these peculiar growths are also induced by various *Uredineæ*, notably by the æcidium (*Peridermium pini*) of *Coleosporium senecionis*, and by *Æcidium* (*Peridermium*) *elatinum*.

The black-knot of the plum and cherry, *Plowrightia morbosa*, is said to occur only in North America, but the author thinks it may be in-

troduced into Europe at any time. This is quite likely and the wonder is that it should not have occurred before, owing to the fact that it is found on all our species of *Prunus* and is very destructive in many parts of the eastern United States.

The volume ends with a brief index, preceded by a convenient synopsis of diseases (215 in number). This is arranged alphabetically according to hosts, and under each host according to organs, so that the reader who knows the name of the host and of the part attacked can quickly refer to the description of the disease in the body of the text.—ERWIN F. SMITH.

KELLERMAN & SWINGLE. *Branch Knot of the Hackberry.* Report of Botanical Department, in First Annual Report of the Kansas Experiment Station, 1888.

This article is especially interesting to lovers of fungi from the fact that it relates to the peculiar double effect of plant parasite and insect irritation upon the same portion of host tissue. The infecting fungus *Sphærotheca phytoptophila*, Kell. & Sw., appears to be a new and quite distinct species, choosing as its home the peculiar formations caused by a *Phytoptus* or gall-mite, which remains as yet undescribed. Many small branches of the hackberry (*Celtis occidentalis*, L.) have upon them knots and clusters of small abnormal twigs, which were supposed to be wholly due to the attacks of insects until the authors of this paper in March, 1888, discovered the mycelium and fruiting-bodies of this new powdery mildew growing upon the buds and stems of the diseased portions. Up to this time only two species of the *Erysipheæ* had been found growing upon the *Celtis*, both of which belong to the genus *Uncinula*, and only one as an inhabitant of Phytoptus galls—a *Microsphæra*. A portion of the article is taken up with a description of the curious distortions caused by the gall-mite and mildew combined, two photo-lithographs of different styles or types being added. Following this is a short account of the general characters of the *Erysipheæ* and a very full and carefully prepared description of the species in question. The presence of *Cicinnobolus Cesatii*, DBy., the common parasite of the powdery mildews, is noted, and shares with the gall-mite a short description. As remedies for this complex disease, which disfigures and enfeebles the hackberry trees—used quite frequently for ornamentation in the West—the authors suggest the use of sulphur and its compounds along with that most effective of preventive measures, a removal and destruction of the diseased portions during the winter season.

Whether or not the fungus and gall-mite are independent of each other the paper does not attempt to decide, but leaves the matter for further experimentation, throwing out the suggestion that it may be possible for the mite to form galls without the fungus, but not for the fungus to live separated from the gall.—D. G. FAIRCHILD.

Scribner, F. L. *Diseases of the Irish Potato.* Bulletin of the Agricultural Experiment Station of the University of Tennessee, April, 1889.

In this paper the author discusses the potato rot, caused by the fungus *Phytophthora infestans*, and a new disease, due to a nematode or thread-worm. After giving a detailed account of the habits of the former, the paper concludes with a chapter on treatment, which is briefly summed up as follows:

Select for planting a light, sandy loam, or a soil which is well drained; plant only perfectly sound or disinfected seed; spray the tops with the Bordeaux mixture* or some preparation containing sulphate of copper; store in a cool *dry* place, and keep dry.

The new disease was discovered among the potatoes obtained from the University farm, and is described as causing the tuber to wither, then dry up, and become hard. The skin is only partially discolored, but the surface is covered with small pimples, each surrounded by a depression. Sections through a diseased tuber revealed the fact that the flesh was apparently sound, but slightly wilted. The only discoloration of the flesh was immediately under the pimples; here the tissues were brown. Under the microscope it was seen that the brown areas were filled with numerous little worms of various sizes and in all stages of development.

"These little worms," says the author, "were at once recognized as nematodes or thread-worms, and were evidently the cause of the disease."

"How did these worms get into the potatoes? Probably from the soil in which they were grown, for it is known that many of the parasitic nematodes spend a certain period of their existence under ground. It is very likely that they were first introduced into the University farm through planting infected seed. The potatoes planted were being saved for seed, and were these to be planted they would certainly carry the worms to the new crop and thus perpetuate the disease."

Owing to the limited knowledge of the life history of the nematode, the author says it is impossible to indicate any definite course of treatment.—B. T. Galloway.

Shipley, A. E., Cambridge, England. On *Macrosporium parasiticum.* Annals of Botany, May, 1888.

This is a note probably called forth by Kingo Miyabe's paper which was reviewed in the last number of The Journal.

In 1887 the author was sent to the Bermuda Islands to study an onion disease prevalent among the onion plantations of the colony and supposed to be due to insect attacks. He found a fungous disease having two stages, the first caused by *Peronospora Schleideniana*, the second by *Macrosporium parasiticum.*

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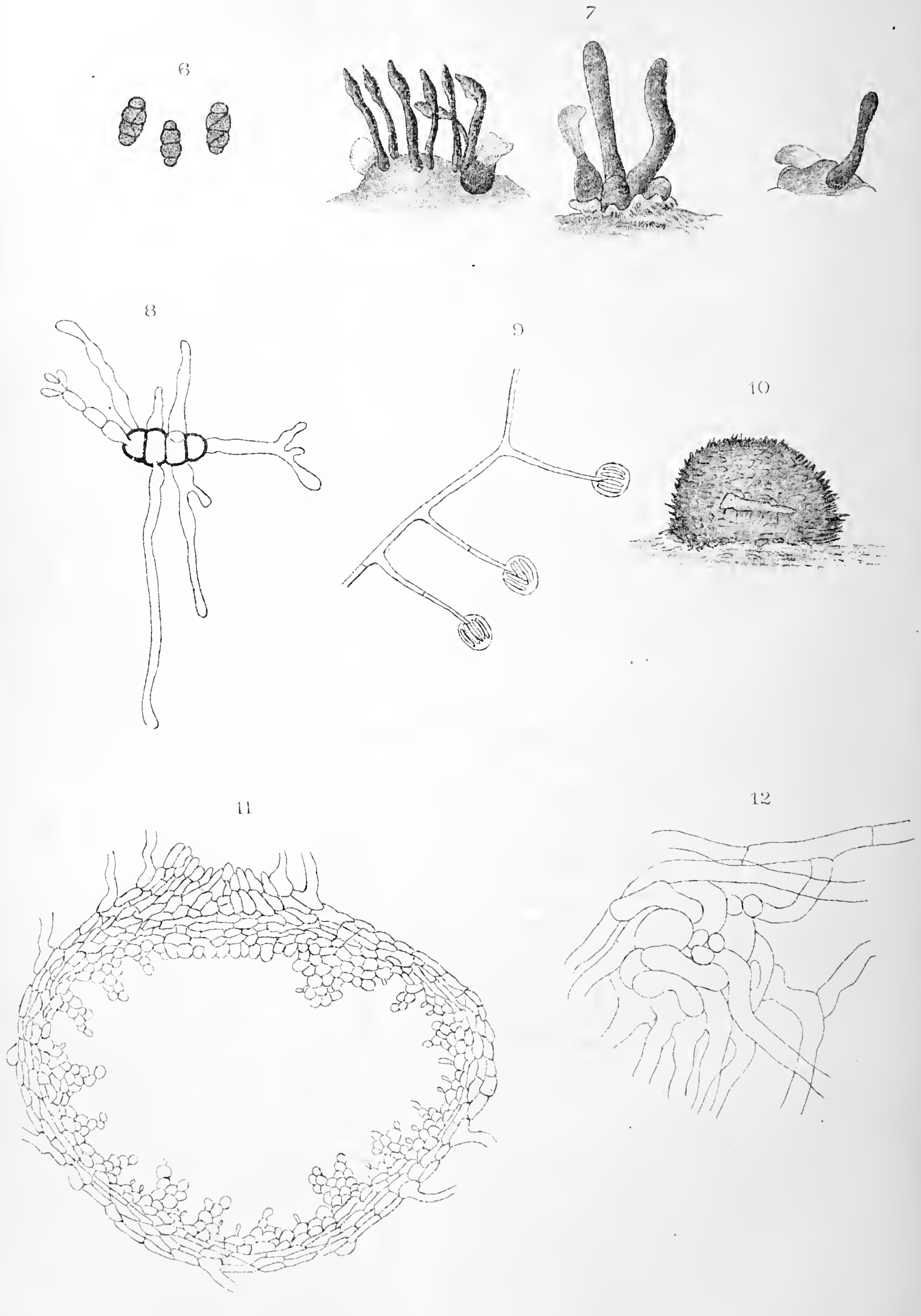
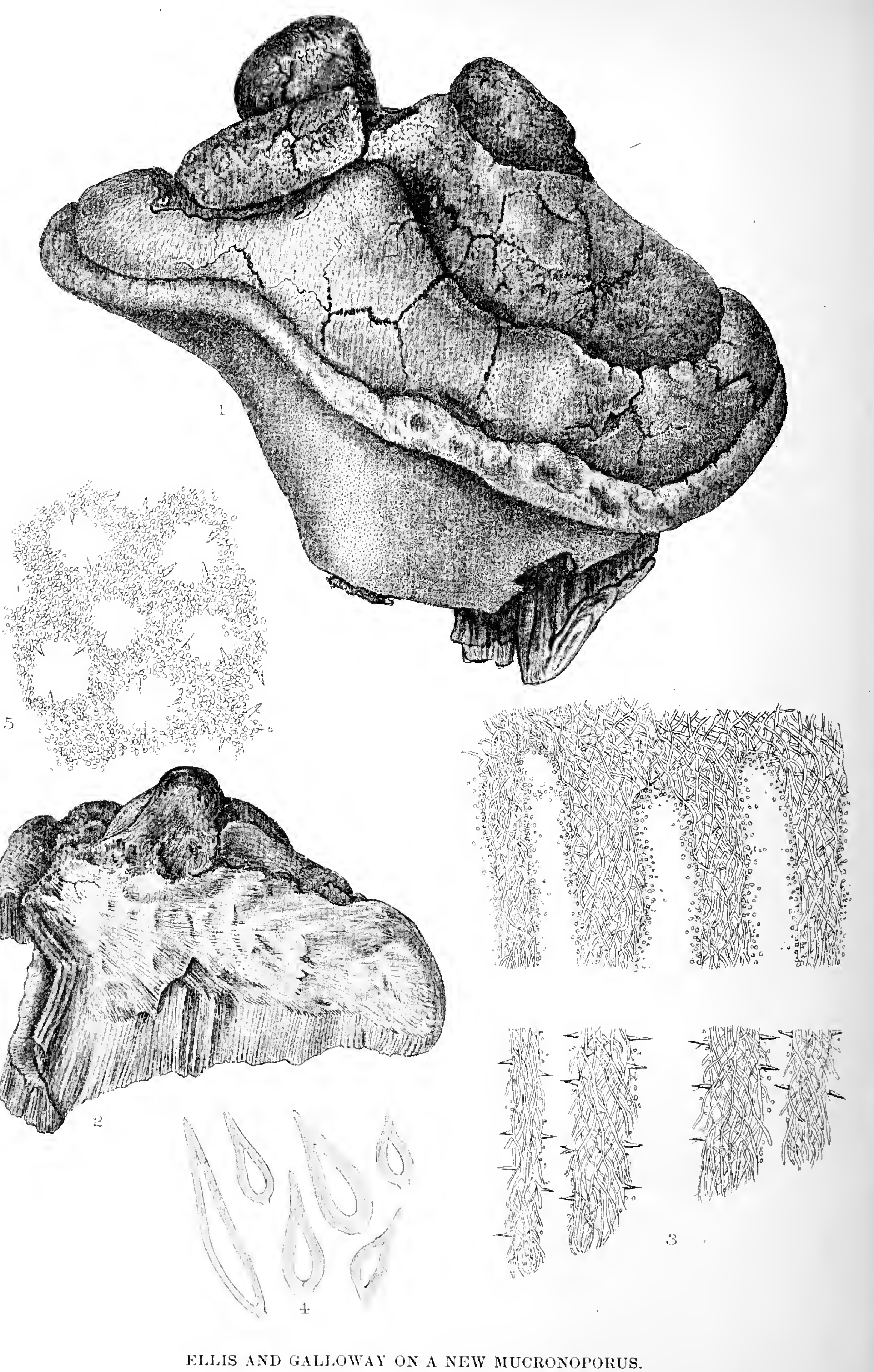
* See Mr. Weed's paper on page 158.



VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

FENESTELLA PLATANI.

A. Hoen & Co. Lith. Baltimore.



ELLIS AND GALLOWAY ON A NEW MUCRONOPORUS.

MUCRONOPORUS EVERHARTII.

A. Hoen & Co. Lith. Baltimore.

The mycelium of the *Macrosporium* ramifies through and not between the cells of the host, and the fertile hyphæ bore their way to the surface through the outer cell wall of the epidermis, their apices apparently exerting some solvent action on cellulose. He has not observed them projecting from the stomata as Mr. Miyabe did.

Mr. Shipley further takes issue with Mr. Miyabe in regard to the parasitism of the fungus. He has never seen a plant suffering from *Macrosporium* that had not previously been attacked by *Peronospora*. In other respects, except the development of the perithecia, which he did not observe, his observations confirm those of Mr. Miyabe.—EFFIE A. SOUTHWORTH.

UNDERWOOD & COOK. *Generic Synopses of the Basidiomycetes and Myxomycetes.*

This is the title of a work designed "as an aid to instructors as well as a guide to students wishing to pursue the study of fungi alone." Accompanying this work are one hundred neatly labeled specimens of fungi illustrating the more important groups. These, together with the synopses, which consist of twenty-one pages bound in a neat octavo volume, sell for $6.00.—B. T. GALLOWAY.

DESCRIPTION OF PLATES.

PLATE XI (*After von Tavel*).

FIG. 6. Ascospores. × 300.
7. External appearance of the stroma with perithecia and pycnidia. Slightly magnified.
8. Germinating ascospore, three days after being sown in water. × 600.
9. Hypha, with gonidiophores of *Acrostalagmus* in moist air. × 300.
10. Young pycnidium. The outer layer has become differentiated and the formation of the cavity has begun. × 80.
11. Vertical section through a pycnidium produced on a leaf. × 214.
12. Early stage of a pycnidium, from a cross-section through an infected leaf. × 700.

PLATE XII.

FIG. 1. *Mucronoporus Everhartii*, natural size.
2. A piece of the same showing length of pores in vertical section.
3. Longitudinal section of pores, with central portion cut out.
4. Spines enlarged.
5. Cross-section of pores.

ERRATA.

Vol. IV, p. 55, change "*Peziza solemæformis*, E. & E." to *Peziza Cazenoviæ*, E. & E., as there is already a *P. solemiiformis*, B. & C.; p. 118, line 4 from bottom, for "1168" read 1158.

Vol. V, p. 69, line 4 from bottom, for "Musie" read Music, and for "Christo" read Cristo; p. 78, line 4 from bottom, for "CYTOSPORINA" read CYTISPORINA; p. 78, line 2 from bottom, for "CYTISPORIUM" read CRYPTOSPORIUM; p. 79, line 11 from top, for "RANII" read RAUII; p. 79, line 13 from top, for "in Lett" read in Litt; p. 79, line 17 from top, for "AMORPHÆ" read AMORPHA; p. 80, in the statement "I have in the herbarium collected the previous year by F. W. Anderson, the following," insert *two* before "following;" p. 84, line 8 from bottom, for "already" read almost.

Dr. Fairman wishes the original Latin descriptions of the two following fungi, described on page 78, published:

DIDYMIUM FAIRMANI, Sacc. *Sp. nov.* Dignostitus peridiis sparsis, sessilibus, floccis hyalinis laxe recticulatis, spores levibus (8–10μ. d.); Crystallis eximie stellatis en; Columella sub globosa fuscella.

CONIOSPORIUM FAIRMANI, Sacc. *Sp. nov.* Ab affin. *C. Apiosporiade* differt conidiis multis minoribus (5–7μ. d.) globosis, levibus, fuligineis, 1 nucleatis.

Compliments of

J. M. RUSK,

Secretary of Agriculture.

U. S. DEPARTMENT OF AGRICULTURE.
SECTION OF VEGETABLE PATHOLOGY.
QUARTERLY BULLETIN. DECEMBER, 1889.

Vol. 5. No. IV.

THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

B. T. GALLOWAY,
CHIEF OF THE SECTION.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

CONTENTS.

CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XIII.)

By Franz von Tavel.

(*Continued from page* 123.)

IV.—Cucurbitaria Platani, *n. s.*

Among the numerous fungi which came under our observation during this investigation, we gave special attention to a *Cucurbitaria.* It was found only on the fallen *Platanus* branches and then sparingly, so that our investigations were necessarily limited to the formation of the pycnidia. For the same reason it was impossible to identify the fungus. It is here designated as *Cucurbitaria platani* n. s., because from a purely practical stand-point the object of an investigation must have a name, and because neither Saccardo nor Winter mention a *Cucurbitaria* growing upon *Platanus.*

The stroma of the fungus is circular and about 2 mm. in diameter. It lies under the bark, which becomes broken through by the perithecia and pycnidia. Generally several stromata stand close together. Twenty fruiting bodies, partly pycnidia and partly perithecia, stand in very irregular order upon a stroma. They are often very close to each other and frequently grow together. The pycnidia have very irregular cavities and thick, intensely black walls. The basidia are filiform, the pycnidia spores extraordinarily small, cylindrical, and colorless. The perithecia are flask-shaped but of very irregular form and without a distinct neck or papilla. Their walls are also black and scarcely project beyond the bark. The asci are 8-spored, cylindrical, obtuse above and suddenly tapering into a short pedicel below.

The spores are light brown at maturity, elliptical, a little smaller at the ends, and strongly constricted in the middle. They usually have six transverse septa, often more or less; the number of the longitudinal septa is very variable. They are 18–25 μ. long by 9–11 μ. broad (Fig. 13.)

The ascospores germinate rapidly even when they have been kept dry for a long time, but they behave very differently in water and in nutritive solutions. When sown in distilled water, sometimes all, and sometimes only single cells of the spore send out germ tubes which

grow rapidly for a long time. On account of the passage of the contents of the spore into the germ tube the former becomes much more transparent; its cells also swell up, but it shows no farther changes. The germ tube soon becomes divided up into short cells at its base. When the nutritive materials in the spore are used up the growth at the end ceases. The entire germ tube then divides up into roundish, much swollen cells, which produce gonidia-like buds.

The results are different when the sowings are made on gelatine which is mixed with a plum decoction, grape juice, or meat extract. The first phenomena of growth are the same. But the terminal growth of the germ tubes does not cease, and they consequently spread themselves over a relatively large area in a very short time. Their cells are therefore not short and thick but elongated, at first at least. In this case spores are not cut off.

The ascospore itself undergoes a considerable transformation. It swells up at first and becomes more transparent as happens when it is sown in water (Figs. 14–16). As the size increases new transverse septa and soon after longitudinal septa make their appearance. These septa become continually more numerous and consequently the whole spore increases in circumference; they appear in the greatest numbers in the central cells of the spore, while the ends change very little for some time. The primary cells may be visible for some time on account of the constrictions at the septa. In the manner described the spore is transformed into a large body easily visible to the naked eye and composed of a considerable number of very small cells, from which the germ tubes, which in the meantime have become large strong hyphæ, now project in different places. About six days after sowing it begins to turn brown and finally becomes so dark colored that further observations of special development are rendered impossible. It can only be seen that the cells composing the interior separate, leaving a cavity. After some time, during which the growth of the body has ceased, gonidia began to emerge from the opening in the apex. We have therefore a pycnidium situated in the center of a mycelium. A special pore which may be recognized by some especially large clear cells, is now started.

The formation of this pycnidium (it may be called a sporopycnidium in order to distinguish it from the others) does not occur when the spores are sown in distilled water; the germ tubes must therefore first grow at the expense of the spore and then take up nourishment from the substratum and carry it to the spore, in order to supply the consumption and furnish a surplus which makes it possible for it to attain such dimensions and pass through such transformations.

The sporopycnidium is a very interesting phenomenon for two reasons. In the first place it is known that by absorbing nutriment, a fungous spore may increase in dimensions and that its cells may divide De Bary (Morphol. u. Biol. d. Pilze, 1884, p. 123.) cites the *Mucorini* and

Sclerotineæ as examples of this. But such a luxuriant growth, connected with such a high degree of cell division, which simultaneously produces the growth of a mycelium from the spore, and changes the latter into a new and complicated organ of reproduction, can scarcely have been observed before.

But the case presents a further point of interest when compared with the formation of other pycnidia. We may discriminate between a symphyogenous and a meristogenous development. Pycnidia arise symphyogenously by an interweaving of hyphæ and meristogenously by the growth and division into cells of a piece of hypha in which the branches of the hypha may share. The sporopycnidium is therefore meristogenous even if it does not arise from a mycelial thread. It represents rather the most extreme case of meristogenous development, arising directly from the division and growth of the spore without the interposition of any foreign element.

Before the formation of this sporopycnidium is completed the beginnings of new pycnidia arise at the periphery of the mycelium. These are of meristogenous origin, yet several hyphæ are concerned in their construction. One or several cells swell up anywhere upon a hypha (Figs. 17–18), and these become divided by walls which are laid down both in transverse and longitudinal directions. In the vicinity of these spots the hyphæ which bound and those which accidentally cross or touch them exhibit the same changes, their cells also enlarging and dividing. In this way these hyphæ nearly fasten themselves to each other. Through continued growth and cell division there arises a many-celled compact body from which many hyphæ apparently originate; but it is from them that the body itself arose. The young pycnidia may attain considerable size without showing any cavity (Fig. 19). At first no differentiation can be seen until the walls of the superficial cells become thickened and brown. The single cells also increase in size with the growth of the whole, but the central portion finally falls behind the periphery, and the cells separate from each other in the center, without, however, as Bauke has shown for *Cucurbitaria elongata*, the process being begun by a very large definite cell. In this way there arises a cavity which enlarges with the growth of the pycnidium (Fig. 20) and is lined by uniform cells. From these grow out filiform basidia, which form a hymenium and cut off very small spores (Fig. 21). The outer wall of the pycnidium is now composed of cells whose contents have been transformed into a dark-colored mass, while the membranes themselves are less deeply colored. Here also are the beginnings of a special pore, as is the case in the sporopycnidium.

These pycnidia develop in essentially the same manner described by Bauke for *Cucurbitaria elongata;* but with this difference, that here the hyphæ which lie against the beginnings of the pycnidium do not merely form the envelope, but instead all the elements have the same functions, as is shown by cross-sections through quite young stages.

The further development of *Cucurbitaria platani* was not followed out. Secondary pycnidia began to develop on the slide in extraordinarily large numbers. The mycelium gradually became transformed into a stroma, the hyphæ continually growing darker, more closely interwoven and smaller celled. A stroma of this kind was placed with the pycnidia upon a fresh *Platanus* branch upon a place where the bark was injured. The stroma soon became completely covered with pycnidia. The peripheral hyphæ penetrated the bark, from which only a few pycnidia followed. After a long time perithecia could also be seen; but they were so few that any investigations were not to be thought of.

The ascospores of *Cucurbitaria platani* were sown upon another branch. It remained intact for a long time, but after it was apparently dead and had begun to decay pycnidia broke out upon the cut surfaces and leaf scars, in short, wherever the bark was injured. It may be concluded from this that *Cucurbitaria platani* is not a parasite but merely a saprophyte. Cultures upon leaves gave no reliable results.

MYCOLOGICAL NOTES.

BY GEORGE MASSEE.

(Plate XIV.)

1. TREMELLA TREMELLOIDES, (Berk.) Mass. (Fig. 1). Tremelloid; lobes fasciculate, *elongated*, *suberect*, almost free to the base or variously united, *compressed*, springing from a small contracted base, *surface scabrid*, dull orange; spores elliptic-oblong with a minute oblique apiculus at the base, 11-12 by 5 μ.

Sparassis tremelloides, Berk., Grev. Vol. II, p. 6; Sacc. Syll., Vol. No. 7926.

On wood, Lower Carolina. (Type in Herb. Berk., Kew, No. 4088). Forming large tremelloid tufts, always springing from a very small basal portion, which penetrates the matrix; lobes suberect, 3–4 inches high in well grown specimens, sometimes smaller, in some specimens variously plicate and almost free to the base; in others the lobes are united laterally and form a gyrose tuft, always much compressed. The distinctly scabrid surface is very characteristic, and is due to thickly scattered papillæ, which give a very harsh feel to dry specimens. Basidia large, sterigmata developed in succession.

STELLA, Mass. (*nov. gen.*).

(Fig. 2.)

Peridium consisting of two distinct layers united at the base only; outer layer thick, splitting in a stellate manner from the apex, inner layer thin, indehiscent; gleba traversed by numerous anastomosing thin tramal plates, which are continuous with the inner wall; columella and capillitium absent; spores forming a powdery mass at maturity.

The present genus occupies an intermediate position between *Scleroderma* and *Geaster*, agreeing with the former in the structure of the gleba, which is broken up into numerous small, irregular cavities by the tramal walls, which become disorganized at maturity, and in the absence of a columella and capillitium, but is generically distinct in having a peridium composed of two separate layers, in which it agrees with *Geaster*, but is again quite distinct from the last-named genus in the total absence of a capillitium, a character which also distinguishes it from *Diplocystis, Diploderma*, and *Cycloderma*, if indeed the last-named genus is founded on anything more than immature species of *Geaster* collected before the splitting of the outer peridium.

2. STELLA AMERICANA, Mass. (*n. s.*). (Fig. 2.) Globoso-depressed, outer layer of peridium thick, *smooth*, *ochraceous-brown*, splitting from the apex in a stellate manner into 4–6 acute subequal segments; inner layer smooth, thin, *pale brown*, becoming disorganized above when mature; mass of spores, *umber*; walls of trama whitish, disappearing; spores globose, *minutely warted*, 6–7 μ in diameter. On the ground, Lower Carolina. (Type in Herb. Berk., Kew, along with *Scleroderma geaster*); from 1–2 inches in diameter, growing singly or sometimes two together.

3. TRICHOSPORIUM CURTISII, Mass. (Fig. 3.) Broadly effused, compact, *blackish-purple*, sometimes with a tinge of brown; hyphæ pale, septate, branched, combined into vein-like anastomosing strands; gonidia very profuse, *purple-brown in the mass*, *smooth*, *broadly elliptical*, rather variable in size, averaging 5 by 3.5–4 μ.

Reticularia affinis, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll., Vol. VII, Part I, No. 1426.

Reticularia atro-rufa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1428.

Reticularia venulosa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1433 (called by mistake *Reticularia venosa.*).

On bark, wood, moss, etc. Lower Carolina, Cuba, Ceylon. (All types in Herb. Berk., Kew.) Superficially resembling a *Reticularia*, but there is no cortex, the surface being perfectly naked. Forming compact cakes, 3–4 inches across and half an inch thick, consisting of a dense mass of hyphæ spreading centrifugally in the form of irregularly anastomosing vein-like strands, produced by the agglutination of hyphæ, brought about by the partial disorganization of their walls. Hyphæ septate, with numerous clamp connections, sometimes minutely scabrid with particles of lime; conidia acrogenous, produced in great profusion, becoming agglutinated into a compact cake along with the hyphal portion of the mass.

4. TRICHOSPORIUM PHYRRHOSPORIUM, (Berk.) Mass. (Fig 4.) Effused, pulvinate, compact, *deep reddish brown*, hyphæ 2–2.5 μ thick, pale yellow, septate; conidia very profuse, produced on the tips of short lateral branches, *globose*, *bright brown*, *smooth*, wall very thick, 6–7 μ in diameter.

Reticularia phyrrhospora, Berk., Journ. Linn. Soc., Vol. X, p. 347 Sacc. Syll., No. 1432.

Reticularia rubra, Ayres, in Herb. Berk.

On dead trees. Mauritius, Cuba. (Type in Herb. Berk.) Forming pulvinate masses 2–3 inches long by 1 inch or more high, seated on a broad base, convex above, sometimes irregular in outline. The conidia are produced on the tips of lateral or terminal branches, the apical cells of which become inflated, and from this inflated apical portion of the terminal cells the conidia are produced; eventually, the inflated apical cell becomes colored like the conidia, and falls away from the colorless supporting hypha; these latter are the bodies referred to by Berkeley as shortly stipitate spores.

5. TRICHOSPORIUM APIOSPORIUM, (B. & Br.) Mass. (Fig. 5.) Broadly effused, *fulvous*, hyphæ agglutinated into radiating dendritic strands; conidia *elliptical, minutely verrucose*, almost colorless, 8–9 by 5 μ.

Reticularia apiospora, B. & Br., Journ. Linn. Soc., Vol. XI, p. 82; Sacc. Syll., 1427.

On dead wood. Ceylon, Lower Carolina. (Type in Herb. Berk.) Broadly effused, thin; hyphæ agglutinated into irregularly branched vein-like radiating strands. The conidia spring from subpyriform apical cells as in *T. phyrrhosporium.*

6. BADHAMIA NODULOSA, (Cke. & Bal.) Mass. (Fig. 6.) Sporangia globose, stipitate, wall very thin, almost colorless above, and covered with an irregular scanty white crust of lime, basal portion without lime and beautifully iridescent, becoming irregularly ruptured at maturity; stem longer than sporangium, *weak, often subdecumbent, brown*, attenuated upwards, longitudinally wrinkled, expanding at the base into a small, irregular hypothallus; columella absent; capillitium well developed, flattened, intricately branching nodes large, irregular, *scantily furnished throughout with granules of lime;* spores globose, dingy lilac, *minutely verruculose*, 8–10 μ in diameter.

Physarum nodulosum, Cke. & Balf., in Rav. Fung. Amer. Exs., No. 479.

On Acacia bark. Aiken, S. Carolina (Rav. 2972). (Type in Herb. Kew.) A very distinct and good species of *Badhamia*, hitherto undescribed so far as I am aware. About 1.5 mm. high, stem twice as long as sporangium, weak, usually subprostrate, capillitium dense, with the characteristic flattenings met with in *Badhamia*, and everywhere containing granules of lime, although the quantity is not so great as is usual in the genus. Sparsely scattered, rarely two springing from the same hypothallus.

7. PHYSARUM SCYPHOIDES, Cke. & Balf. (Fig. 7). Sporangia globose or broadly obovate, stipitate, *upper portion of wall whitish*, rough with amorphous lumps of lime, basal portion *bright brown, persistent as a very shallow, irregular cup;* stem about equal to sporangium in length, *bright brown*, erect, usually attenuated upwards, irregularly wrinkled

and often compressed and twisted, expanding at the base into a minute brown hypothallus; capillitium dense, knots of lime white or yellowish, very numerous, large, irregularly branched, connected by short thin portions, *becoming concentrated towards the base of the sporangium to form a columella;* spores globose, lilac-brown, *minutely warted*, 7–9 μ in diameter.

Physarum scyphoides, Cke. and Balf., in Rav. Fung Amer. Exs., No. 480.

On living leaves, grass, etc. Darien, Ga. (Rav. 2407). (Type in Herb. Kew). A fine species, about 1 mm. high, scattered or gregarious, the upper portion of the sporangium whitish, chalky, with sometimes a suggestion of pink, falling away in patches when mature, and leaving the small, thicker, basal portion in the form of an irregular shallow cup or disc, which, with the character of the sporangium, suggest a leaning toward the genus *Craterium.* It is perhaps a mistake to issue new species in exsiccati before the specific diagnoses have been published.

8. Tilmadoche gyrocephala, Rost. (Fig. 8.) Sporangia stipitate irregularly globose or compressed, *variously lobed and lacunose, umbilicate below*, wall thin, at first frosted with minute greenish-yellow granules of lime, dehiscing irregularly; stem equal to or longer than sporangium, attenuated upwards, strongly wrinkled longitudinally, expanding downwards into an irregular hypothallus, *yellow or orange;* columella absent, capillitium well developed, forming a rigid, irregular net-work; *swellings small, fusiform*, containing yellow granules of lime; spores globose, dingy lilac, *minutely verruculose* 9–12 μ in diameter.

Tilmadoche gyrocephala, (Mont.) Rost. Mon., p. 131; Sacc. Syll., No. 1248.

Physarum Schumacheri, Spr., Rav. Fung. Amer. Exs., No. 4778.

Didymium gyrocephalum, Mont., Ann. Sci. Nat., Ser. II, Vol. VII, p. 362; Mont. Syll., No. 1073.

Cribraria straminiformis, Speg., Fung. Arg., pug. II, No. 109.

On twigs, leaves, etc., Brazil; Argentine Republic; S. Carolina.

Scattered or gregarious 1.5 to 2 millimeters high, characterized by the *gyrose* and *lacunose sporangium*, which, judging from the simple, thin stem, is not an æthalium, as is the case in some species of *Trichia, Hemiarcyria* and other genera, where the clustered and fasciculate compound stem proves conclusively the ethaloid nature of the complex sporangium.

Kew, England.

A PRELIMINARY LIST OF THE ERYSIPHEÆ OF MONTANA.

By F. W. Anderson.

Whatever effect the abundance or scarcity of rain, or the degree of atmospheric and terrestrial humidity from other sources, may have upon the propagation of *Peronosporeæ* and *Uredineæ*, it is certain that the *Erysipheæ*, in Montana at least, are not very materially affected by even an unusual lack of such moisture. Montana this year, in company with many other Western States, has suffered from an almost unprecedented drought. Yet, while all ordinary vegetation languishes, and while *Uredineæ*, usually so abundant everywhere, are hard to find, the *Erysipheæ* have appeared on most of their usual hosts in fair abundance.

In looking over the published Lists of *Erysipheæ* from various States, or in comparing herbarium specimens of a given species on the same or different hosts from a number of States, one is struck at once by the wide range of variation in the specific characteristics of that species. This is especially noticeable where a species has a wide geographical distribution and a great number of hosts belonging to different families. In fact, it is frequently a difficult task to assign some of these forms which may be intermediate between two related and variable species. For example: Within the range of the two common species of the genus *Erysiphe*—*E. communis* and *E. cichoracearum*—we find at times the most perplexing variations of all kinds, from the form and disposition of the mycelium, up to the number and size of the asci and spores. One is sometimes tempted to think that they are but one "running" species, or else that some day an intermediate specific rank will be erected to embrace the more radical of the intermediate variations from the two types. One or the other alternative must sooner or later be adopted in order to find a resting place for some of the Rocky Mountain forms which are clearly neither the one nor the other, but which are certainly intermediate. There are species in other genera also which would be made easier to deal with by a similar modification. I hope in a future paper to discuss our peculiar Rocky Mountain forms more fully, and with this object in view it may not be out of place at this time to ask botanists of the Rocky Mountain region to send me specimens of the species and forms common to their several localities. I should be happy to send them good specimens from Montana in exchange.

This short preliminary list is published with the hope that other resident or traveling botanists in Montana may be stimulated to a more earnest study of this important family. The species have been collected by myself on the hosts and in the localities given except as otherwise indicated. Spring Hill is on the Idaho border at the southwest, west of the main divide. The Valley of the Teton is near the British line

at the north and east of the main divide. Montana contains 143,776 square miles, and is more than twice as large as all the New England States put together, so that some of our species have a very fair range. I have found that where a host common throughout both sides of the main divide of the Rockies occurs, the fungus will be found throughout also.

SPHÆROTHECA MORS-UVÆ, (Schw.) B. & C. Hosts: *Ribes floridum*, Helena (Kelsey); *R. cereum*, Helena and Great Falls; *R. rotundifolium*, Sand Coulee. Mycelium at first white, but soon becoming dark brown, forming a dense felt over the succulent twigs and young leaves of *Ribes rotundifolium;* occurring also upon the berries. On *Ribes cereum* it is less frequent, and usually grows in small isolated belts around the young twigs. At times very injurious to the gooseberry. Unusually prevalent this year.

SPHÆROTHECA CASTAGNEI, Lév. Hosts: *Geranium incisum*, Helena (Kelsey), Sand Coulee, Belt Mountains; *Geranium Richardsoni*, Belt Mountains; *Gilia linearis*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Willis, Glendale, Dillon, Spring Hill, and Valley of the Teton; *Gilia gracilis*, Belt Mountains; *Shepherdia argentea*, Valley of the Teton, throughout on *Gilia linearis*, frequently killing it; covering all parts of the plant above ground. The thousands of black perithecia, mixed with the gray mycelium, make infested plants look as if covered with small particles of black soil mixed with dust. Rare on *Gilia gracilis.* On *Shepherdia argentea* the disposition of the mycelium was much like that of *Sphærotheca mors-uvæ*; but more delicate, colorless, or faintly creamy-yellow tinged, and not so evident; that is to say, it attacks the tender twigs of the tree and surrounds them, causing injury to the leaves above by perversion of nutrition. It is also very partial to the leaf axils. My specimens were collected July 16, this year. The ascospores are formed, but the fungus is not mature. Mr. J. B. Ellis, who kindly compared my specimen with one from Dr. Farlow, agrees with me that it must be referred as above. Common in the mountains on *Geranium incisum* and *G. Richardsoni*, often thickly covering the petioles, leaves, stems, and even the petals, sometimes causing the leaves to curve to the ground with the weight of fungus and destroying them.

A quite remarkable form of this species was found on *Heuchera parvifolia.* Anderson No. 212. Sand Coulee, Cascade County, Mont., December 3, 1888. Its most marked peculiarity is in the mycelial threads, which have a tendency to grow to a great length without ramifying to any extent, and end in long, slender, cylindrical, colorless threads. Moreover, they show marked constrictions at nearly regular intervals, at which they are septate. The appendages can be readily distinguished from the mycelium, are strongly colored for about one-third to one-half their length, and then gradually fade to the almost hyaline tip. Like the mycelium, they are septate and show a tendency to elongate without

interweaving much with other threads. Conidia-bearing branches are scarce, and the only perfect (?) one I could fine bore three conidia.

Erysiphe communis, (Wallr.) Fr. Hosts: *Œnothera albicaulis*, Sand Coulee; *Oxytropis Lamberti*, Sand Coulee, Great Falls, Valley of the Teton, Craig, Helena, Deer Lodge, Dillon, Spring Hill; *Astragalus Canadensis*, Helena (Kelsey), Belt Mountains; *A. multiflorus*, Belt Mountains; *A. decumbens*, Belt Mountains; *A. hypoglottis*, Sand Coulee, Helena, Willis; *Pisum* (cultivated), Willis, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee; *Trifolium longipes*, Deer Lodge Valley and Belt Mountains; *Lupinus parviflorus*, Deer Lodge and Spring Hill; *Amelanchier alnifolia*, Helena (Kelsey), Sand Coulee; *A. maculatum*, Sand Coulee; *Ranunculus repens*, Helena, Deer Lodge, Willis; *R. macranthus*, Great Falls, Belt River; *R. Cymbalaria*, Sand Coulee, Helena, Deer Lodge, Dillon, Willis, Glendale, Melrose, Spring Hill, Valley of the Teton; *R. sceleratus*, Sand Coulee, Helena. Doubtless on many other hosts. The forms on *Ranunculaceæ* commonly have very dark appendages, especially the form on *R. Cymbalaria*. The appendages of the forms on *Leguminosæ* are lighter or even entirely colorless, and often indistinguishable from the mycelium at maturity. This fungus is especially destructive to *Ranunculus Cymbalaria, Oxytropis Lamberti*, and cultivated *Pisum*.

Erysiphe galeopsidis, DC. Host: *Stachys palustris*, Helena (Kelsey), collected August 26, of this year, but not well matured. The abundant mycelium develops on all parts of the plant above ground. Occasionally asci are seen nearly double the ordinary length, constricted at the middle and septate; they were seen (several in one perithecium and one or two in others) clustered with the other asci. The spores, which are not mature, are usually narrowly elliptical to linear and acute at both ends.

Erysiphe cichoracearum, DC. Hosts: *Mertensia Sibirica*, Belt Mountains; *Phacelia Menziesii*, Silver City (Kelsey); *Parietaria debilis*, Sand Coulee; *Verbena hastata*, Helena (Kelsey); *Galium Aparine*, Sand Coulee; *Echinospermum Redowskii*, Helena (Kelsey); *Solidago Missouriensis*, Sand Coulee, Belt Mountains; *S. serotina*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Dillon, Spring Hill; *S. rigida*, Sand Coulee, Belt Mountains, Belt River, Craig, Helena, Deer Lodge, Butte, Silver Bow Junction, Dillon, Willis, Spring Hill, Valley of the Teton; *S. nana*, Belt Mountains; *S. occidentalis*, banks of the Upper Missouri River; *Aster lævis* and forms, Sand Coulee, Belt Mountains, Helena, Deer Lodge, and Dillon; *A. conspicuus*, Belt Mountains; *A. longifolius*, Belt Mountains, Helena, Warm Springs Asylum; *A. commutatus*, Sand Coulee, BeltRiver, Cora Creek Station, Great Falls, Helena, Deer Lodge, Dillon, Willis; *A. canescens* and forms, Sand Coulee, Belt Mountains, Belt River, Mt. Helena, Deer Lodge, Warm Springs Asylum, Spring Hill; *A. multiflorus*, Belt River, Otter Creek, Cora Creek Station; *A. foliaceus* and vars., Sand Coulee, Helena, Deer Lodge, Dillon, Warm Springs Asylum; *A. adscendens*, Belt River; *Erigeron macranthus*,

Elkhorn (Kelsey), Belt River, Belt Mountains, Sand Coulee, Helena, main range of the Rockies, Deer Lodge, and Willis; *E. glabellus*, Belt Mountains; *E. divaricatus*, Sand Coulee, Belt Mountains; *E. Canadensis*, Sand Coulee, Helena, Dillon; *E. corymbosus*, Belt Mountains; *E. armeriæfolius*, Helena; *E. strigosus*, Sand Coulee; *Helenium autumnale*, banks of the Big Hole River, near Willis; *Helianthus annuus*, Helena (Kelsey); *H. Californicus*, var. *Utahensis*, Helena (Kelsey); *Gaillardia aristata*, Mount Helena; *Lactuca pulchella*, Sand Coulee; *Artemisia dracunculoides*, Belt Mountains, Belt River, Cora Creek, Otter Creek, Chinook, Valley of the Teton, Sun River, Fort Shaw, Fort Assinniboine, Sand Coulee, Craig, Helena, Garrison, Deer Lodge, Butte, Silver Bow Junction, Silver City, Willis, Melrose, Glendale, Spring Hill; *A. Ludoviciana*, Belt Mountains, Valley of the Teton, Belt River, Otter Creek, Helena, Craig, Deer Lodge, Dillon, Warm Springs Asylum, Willis, Great Falls, Sand Coulee, Sun River; *A. discolor* and forms, Belt Mountains; *Bigelovia graveolens* and vars., Falls of the Missouri River, Helena, Deer Lodge, Warm Springs Asylum, Dillon, Glendale, Melrose, Willis, Chinook, valley of the Teton, Spring Hill; *B. Douglasii* and forms, Mount Helena, McCarthy Mountains, Willis, Deer Lodge, Spring Hill; *Chrysopsis villosa* and forms, Sand Coulee, Deer Lodge, Willis; *Grindelia squarrosa*, Sand Coulee, Helena, Deer Lodge, and Willis; *Cnicus undulatus*, Sand Coulee, Helena, Deer Lodge, McCarthy Mountains near Willis, valley of the Teton; *Gutierrezia Euthamiæ*, Sand Coulee and Deer Lodge.

A number of the forms of *Erysiphe cichoracearum*, DC., to be found on the hosts given are far from typical—especially on certain of the *Compositæ*, and are placed here because at present there is no other place to put them. In some, one, in others another character fails, and again nearly all may fail; not the least important of which is to be considered the remarkable variation in the number of spores to an ascus. In the *Verbena hastata* specimens the asci contain frequently but one spore and that of but average size. The perithecia of *Phacelia Menziesii* specimens are very dark, in marked contrast with the rather pale appendages. All parts of the plant are overrun by the fungus. The fungus covers *Echinospermum Redowskii* entirely. Sometimes large patches of the host growing in dry gravelly places along railway tracks are almost white with growth of mycelium. *Parietaria debilis* suffers so severely from this fungus that its leaves rot on the stems, and if one attempts to pull a leaf off it is no uncommon thing for an irregular piece to come away between one's fingers, leaving the other dilapidated portion still hanging. In *Compositæ* the *Artemisiæ*, with *Aster foliaceus*, *Aster canescens*, and *Aster commutatus* suffer most severely. Cultivated plants do not appear to be infected. In connection with the fungus on *Cnicus undulatus*, collected at Helena, I found the conceptacles of *Cicinobolus Cesatii*, DBy. They were confined chiefly to the conidia-bearing hyphæ, pale in color and small, probably young, for no spores were seen to

escape from crushed conceptacles. They produced no perceptible distortions in the form of the host hyphæ, their own hyaline, delicate mycelium running along the center of the hyphæ for great lengths. I regret that no drawing or fuller notes were preserved. Recently, I have found the same fungus in the hyphæ of *Erysiphe cichoracearum*, DC., on *Gutierrezia Euthamiæ*. The host mycelium was much distorted; here and there colored brown and containing a brownish granular substance—probably the forming conceptacles of the *Cicinobolus;* while, at intervals, the mature conceptacles, varying much in size, arose directly from the usually prostrate hyphæ. Some of these conceptacles were larger than the half-grown perithecia of their host. Their mycelium appeared to ramify with the ramifications of the host mycelium and the conceptacles were most frequently developed near the terminal of a host hypha, or at the terminal of one of its branches, or sometimes from the center of a hypha. Although young and half-grown perithecia of the host were in fair abundance, there was a great scarcity of vegetative mycelium, unusual in this species on any of our hosts. Conidia were also scarce, and it is extremely probable that they were prevented from so much as partially forming by the fructification of the *Cicinobolus* taking possession of the conidial branches at an early stage of their growth. The *Cicinobolus* spores could be found in great numbers, issuing from the ruptured conceptacles. They varied somewhat in shape, occasionally slightly constricted at the middle; usually straight and oblong or narrowly oval. They soon scattered in every direction under the cover glass. None of them appeared to be nucleate.

ERYSIPHE GRAMINIS, DC. Hosts: *Glyceria nervata*, Sand Coulee; *G. aquatica*, Sand Coulee; *Agrostis exarata*, Sand Coulee; *Beckmannia erucæformis*, Sand Coulee; *Hordeum jubatum*, Sand Coulee; *Poa tenuifolia*, Sand Coulee, Helena, Deer Lodge, Willis, and Spring Hill; *Agropyrum glaucum*, Sand Coulee, Great Falls, and Sun River Valley. This common fungus has been found to have mature ascospores in October on *Beckmania erucæformis*, *Hordeum jubatum*, and *Poa tenuifolia*. Perithecia varying in size have been found on all but the *Agrostis exarata*. On *Poa tenuifolia* the ascospores are mature by November, and usually by the middle of October. Professor Galloway informs me that in Missouri, on another species of *Poa*, this fungus was found by Prof. S. M. Tracy containing ripe ascospores in July. In the forms on all the grasses mentioned excepting *Agropyrum glaucum*, the mycelium is at first snow white, and so far as seen never turns yellow or brown, although with age it may assume a grayish tint. The fungus occurs mainly on the upper surface of the leaves in *Beckmannia erucæformis* and *Hordeum jubatum;* on the other grasses it is found abundantly on both surfaces. The form on *Agropyrum glaucum* is colored, almost if not quite from the first, and soon becomes brown or even rusty red, dense and felted, forcibly reminding one of the mycelium of *Sphærotheca mors-uvæ* by its appearance *en masse*. In pressing or drying it loses much of its characteristic appearance.

I have not examined the perithecia of specimens collected later than August, at which period the spores are unformed, or at most only just beginning to show around the inner wall of the ascus. So far as this could be studied it accorded better with the description of the European plant than most of those in my herbarium bearing the same name from any American locality. But none of ours that I have seen agree with the number of asci given in the description "asci 8–16," while ours are 10–25, commonly the greater number. The form on *Poa tenuifolia* does not at all accord with the description and may yet be separated as a good species. This fungus is remarkably destructive to the *Poa* and may be found literally covering it—as if a bucket of whitewash had been spilt over the grass—even on dry, gravelly hills from 7,000 to 9,000 feet high. Deer Lodge Valley is in altitude over 6,000 feet and the high hills and mountains in the vicinity, which are dry and nearly bare of other vegetation than a sparse growth of this grass, form a rich collecting ground for various *Erysipheæ*. *Erysiphe graminis* on *Poa tenuifolia* will be found an excellent subject for those who wish to study the development of the mycelium from the conidia and the sexual organs and ultimate fruit from the mycelium.

UNCINULA SALICIS, (DC.) Winter. Hosts: *Salix glauca* (a form) Helena (?) (Kelsey), Belt Mountains; *S. rostrata*, Belt Mountains; *S. longifolia*, banks of the Upper Missouri River, and Dillon; *S. amygdaloides*, banks of the Upper Missouri River, valley of the Teton, and Sun River Valley; *S. cordata*, banks of the Upper Missouri River; *S. flavescens* and vars., Belt Mountains, Helena, Deer Lodge, Warm Springs Asylum, McCarthy Mountains, Melrose, Spring Hill; *Populus tremuloides*, Sand Coulee, Helena, Deer Lodge, Willis, Spring Hill; *P. monilifera*, banks of the Upper Missouri River, Deer Lodge, Dillon, Willis; *P. balsamifera*, Deer Lodge, Dillon, Willis, Spring Hill; *P. angustifolia*, Helena, Deer Lodge, Willis. This beautiful species is widely distributed and varies considerably on the different hosts, especially as regards appendage tips and number of spores in an ascus. In some instances the appendage tips are almost straight and scarcely swollen in well matured specimens; but such variations are to be expected and are of no specific importance within certain limits.

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. Hosts: *Heuchera parvifolia*, Sand Coulee; *Typha latifolia*, Helena; *Betula occidentalis*, Helena (Kelsey); *Cornus stolonifera*, banks of the Upper Missouri River, Helena, Dillon, Willis, Spring Hill; common and variable; sometimes causing marked injury to the leaves of hosts.

PODOSPHÆRA OXYACANTHÆ, (DC.) DBy. Host: *Prunus Virginiana*, Sand Coulee, Mount Helena. More prone to attack the leaves of vigorous shoots in shady places. Not particularly abundant.

MISCROSPHÆRA SYMPHORICARPI, Howe. Hosts: *Symphoricarpus occidentalis*, Sand Coulee, Belt River, Sun River Valley, Craig, Helena, Deer Lodge, Dillon, banks of the Big Hole River near Willis, banks of

the Red Rock River near Spring Hill, Valley of the Teton; *S. racemosus* var. *pauciflorus*, Belt Mountains. More prolific on the former host; sometimes covering both surfaces of the leaves, causing them to fall before their season.

MICROSPHÆRA GROSSULARIÆ, Lév. Hosts: *Ribes rotundifolium*, Sand Coulee; *R. floridum*, Sand Coulee and Helena; *R. nigrum* (cult. black currant), Sand Coulee. The perithecia and contents usually mature in late autumn, when the leaves begin to fall.

MICROSPHÆRA RAVENELLII, Berk. Hosts: *Astragalus adsurgens*, Sand Coulee, Helena, Deer Lodge, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee, Helena, Deer Lodge, Willis, Belt Mountains, and the Valley of the Teton. Very abundant on the latter host, stunting its growth and preventing the production of flowers.

It will be evident from the following table that there are still many common and good-sized families whose members are attacked by *Erysipheæ* that are not represented in our list. Active workers may expect a rich harvest in Montana for several years to come. The work is in its infancy here, and the only active students are Mr. Kelsey and myself. We want more in the field. I have made several flying trips to points all over the Territory, only getting together a dozen species on ninety odd different hosts. What we need is more local collectors who can do thorough work in their own vicinities. This want will doubtless be supplied as our new State grows older.

Orders represented among host plants.	Number of genera in the order.	Number of species in the order.
Ranunculaceæ	1	4
Geraniaceæ	1	3
Sapindaceæ	1	1
Leguminosæ	4	10
Rosaceæ	2	2
Saxifragaceæ	2	5
Onagraceæ	1	1
Cornaceæ	1	1
Caprifoliaceæ	1	2
Rubiaceæ	1	1
Compositæ	11	35
Polemoniaceæ	1	2
Hydrophyllaceæ	1	1
Borraginaceæ	2	2
Verbenaceæ	1	1
Labiatæ	1	1
Elæagnaceæ	1	1
Urticaceæ	1	1
Cupuliferæ	1	1
Salicineæ	2	10
Typhaceæ	1	1
Gramineæ	6	7
Total in twenty-two orders	44	93

rysipheæ represented by 6 genera and 13 species.

STATUS OF THE SORGHUM BLIGHT.

By W. A. Kellerman and W. T. Swingle.

Attention is called to two papers, whose titles in full are as follows:

(1) *Notizie preliminari sopra alcuni fenomeni di fermentazione del Sorgo saccarino vivente* (Preliminary notice concerning phenomena of fermentation in living saccharine sorghum). *Nota dei Socii correspondenti Palmeri e Comes. Adunanza del dì* 1° *dicembre* 1883. *Estratto dal Rendiconto della R. Accademia delle Scienze fis. e mat. di Napoli. Fascicolo* 12° *diccmbre* 1883.

(2) *Una Rivendicazione di Priorità sulla Malattia del Sorgo saccarino* (A vindication of priority concerning the malady of saccharine sorghum). *Pcl Socio Dr. O. Comes. Adunanza del dì* 8 *agosto* 1889. *Estratto dal Rendiconto del Reale Istituto d' Incoraggiamento. Fascicolo* 7° *e* 8° *luglio e agosto* 1889.

The authors of the first paper, Professors Palmeri and Comes, noticed in 1882 in the expressed juice of saccharine sorghum minute forms similiar to ferments, but they made no further observations in regard to the same until the following year. In 1883 they found at Castellammare (Italy) that the canes presented a conspicuous coloration; in some cases the whole interior portion of the cane was red. This condition gave rise to the suspicion that here was presented the effect of the attack of *Ustilago Reiliana*, Kühn. But on the other hand, they noticed an increase of temperature in a bundle of canes, which was still more marked in a heap of reduced cane awaiting the extraction of the juice. The juice obtained was red in color and immediately underwent spontaneous alcoholic fermentation which was accompanied, or at least immediately followed, by an acetic fermentation. Examination was then made to determine whether fermentation took place in the juice previous to its extraction. For this purpose a cane was made use of that had been in store for eight days. It was cut into small pieces, put into water and subjected to distillation. The distilled liquid gave an alcoholic odor and furnished also, with Muntz's method, evidence of alcoholic content.

Professors Palmeri and Comes then sought to determine whether similar results would be obtained both in the vigorous growing canes attacked with the *Ustilago*, and also in healthy and uninfected plants. They took for this purpose from a farm at Ponticelli a few plants presenting the red discoloration, and others that showed no signs of the disease. Distillation one hour later resulted in the detection of alcohol in the case of the red canes, but none was found in case of the normal and healthy plants.

Sound canes were uniformly found to be white within, but affected ones were a red orange color. The coloration appears first in the fibrovascular bundles. It is light yellow, but in marked contrast to the

adjacent tissue. Later the color deepens to a more or less intense orange, and the fibro-vascular bundles appear as red lines. Finally the adjacent tissue also becomes colored, first at isolated points and then throughout. At this stage the fibro-vascular bundles become altered to a brown color. The red coloration may be manifest, both in the tissue of the internode and in the leaf sheath, or it may be limited to the leaf sheath. In the latter case the corresponding fibro-vascular bundles of the internode are slightly yellow, and those of the leaf sheath are violaceous. But if the internodes and leaves are contemporaneously reddened it was found that the fibro-vascular bundles of the leaves first redden; then the coloration passes along the bundles into the stems. If the node be examined in longitudinal section the red strands will be seen entering from the leaf sheath. In fact the fibro-vascular bundles (with the surrounding tissue) are colored their entire length, and the coloration passes from the leaf to the node, thence with the elaborated sap through the internodes.

Upon microscopic examination the investigators found the red coloration to be due to a deposit on the cell walls. Under strong magnification colorless micro-organisms of various sizes and forms were detected. The larger ones were elliptical, the smaller almost spherical and highly refractive. The first propagate by budding and appear in colonies of two or three individuals united by germination. Some of them are homogeneous, but many present a luminous point in the center or a point at each end; still others have three points, namely, one in the middle and one at each end. The presence and number of these luminous points depend on the stage of development of the cell. Their length ($5–7\mu$) is about twice their breadth ($2–3\mu$).

These micro-organisms, according to Professors Palmeri and Comes, probably correspond to the species figured by Bonorden, Handb. All. Mykol. taf. I Fig. 2 and called *Hormiscium sacchari.* This ferment is very probably the same as that which was afterwards named by Rees *Saccharomyces ellipsoideus.* The spherical or subspherical micro-organisms mentioned above are scarcely 1μ long and present an active vibratory movement. They should perhaps be referred to *Bacterium termo*, Djr., which is commonly found in juices and tissues undergoing decay.

A positive demonstration of the mode of entrance of the germs into the tissue is not claimed, yet it was suspected from observations above given that they enter from without—which is corroborated by the following. "Not only is there a whitish cereous coating, but also another, especially under the sheaths of the affected stems, which is frost-like, greasy white, and cinereous. Microscopic examination reveals the fact that this lime-like coating consists of myriads of organisms like those found in the juices. The diseased plants remaining on the ground afford in their amylaceous or saccharine contents opportunity for increase of the micro-organisms, which are then finally wafted hither and

thither by the breezes. Disseminated in this manner they reach the leaves of the sorghum plants, upon which, in the presence of mists and rain, they multiply and pass through casual wounds or through stomates into the leaves, thence with the elaborated sap to the tissues of the stalk." This hypothesis is supposed to be justified further by the observation that the disease was more intense during the spring fogs and on manured soil where the development of such germs is common. This was the case at Castellammare, where the material for study was obtained.

We have thus given in detail the account of these interesting investigations (in fact this may be considered for the most part merely a free translation of the paper) though carried on five years ago, for the reason that no extended notice of the same has hitherto been given in this country. It was reviewed in the *Botanisches Centralblatt* XXIII, 19 (1885).

In the second paper "Vindication of Priority," Dr. O. Comes, after referring to Professor Burrill's and our own investigations of the Sorghum disease, calls attention to his researches published in 1883 and maintains most positively that the disease studied by himself and Professor Palmeri is the same as that discovered by Professor Burrill in Illinois and further studied by us in Kansas.

Professor Burrill's accounts are as follows: "A Disease of Broom-corn and Sorghum," in the eighth annual meeting of the Society for the Promotion of Agricultural Science, 1887, pages 30–36, and in the Fourteenth Report of the Board of trustees of the University of Illinois for the two years ending September 30, 1888, pages 215–222; and "Disease Germs; another illustration of the fact that bacteria cause disease," in The Microscope, Vol. VII, No. 11, pages 321–331, taken from the Transactions of the American Society of Microscopists, 1887. Our accounts are as follows: "Preliminary Report on Sorghum Blight" in Experiment Station, Kansas State Agricultural College, Bulletin No. 5, pages 56–60, December, 1888; and "Sorghum Blight" in the First Annual Report of the Kansas Experiment Station, State Agricultural College, for the year 1888, pages 281–315.

It is not so clear to us as it is to Dr. Comes that the disease detected by him is the same as that studied by us, and for conclusive evidence we await further investigation on both sides. Dr. Comes dealt with a form of disease characterized by evident alcoholic (and acetic) fermentation. No fermentation whatever was detected either by Professor Burrill or ourselves. Stress it seems to us should be laid on this fact.

He says, in reference to the microbe which he found, that he first thought he had to do with a saccharomycete, but convinced himself the following year that it was a schizomycete and referred to *Clostridium butyricum* (Pasteur), Praz. in "*Il marciume delle radici e la gommosi nella vite*, Napoli, 1884" We would note in reference to this species that ac-

cording to Prazmowski, "*Untersuchungen über die Entwickelungsgeschichte und Fermentwirkung einiger Bacterianarten* and the description in Schrœter's "*Kryptogamen-Flora Schlesiens*," III, Band, Pilze, S. 166, it is a very different organism from *Bacillus sorghi*, Burrill. As figured by De Bary, "Lectures on Bacteria," 2nd. Ed., English translation, page 100, Fig. 13, it somewhat resembles the form shown by us, Plate IV. Fig. 5, *l. c.* which is wholly unlike *Bacillus sorghi*. In the latter no germination of the spores could be seen, while in *Clostridium butyricum* they are said to germinate from the end and are so figured by Prazmowski, *l. c.*

Dr. Comes further says that not having material at hand at the time of writing the "Vindication" he was unable to confirm his former reference of the microbe to the one previously described or to determine whether it be new (*Bacillus sorghi*) as Professor Burrill decided. He says that the description and figures given by Bonorden correspond precisely to the microbe under examination, and also states that his own description of the organism corresponds exactly to that made by Burrill, and to the Figures 1, 2, 3, 4, 5, and 6, Plate IV, of the Report of the Botanical Department of the Kansas Experiment Station, 1888, except that his is a little larger than ours. Now, it should be noticed that whereas our Figures 1, 2, and 3 represent the *Bacillus sorghi*, Figures 5 and 6 represent Bacilli very different in size and character and only occasionally found as impurities in cultures.

The difference in size of the micro-organisms found by Dr. Comes and of *Bacillus sorghi* is by no means inconsiderable. His were 5–7μ long and 2–3μ wide. The measurements of *Bacillus sorghi* are only $1\frac{1}{3}$–4 by $\frac{1}{2}$–$1\frac{1}{4}\mu$, mostly $1\frac{1}{12}$–3 by $\frac{3}{4}$–1μ. Moreover, if Bonorden's figures (taf. I, Fig. 2, and description of species page 33, *l. c.*) be examined it will be seen that they are very different from our figures of *Bacillus sorghi* referred to by Dr. Comes, and Bonorden's can not for a moment be regarded as representing the species with which we had to deal.

The *Micrococcus* figured by us (Plate IV. Fig. 4. *l. c.*) was also found by him and referred to *Bacterium termo*. The figure alluded to, no less than our (unpublished) description of the organism, shows that it is not *Bacterium termo*, but a *Micrococcus* measuring only $\frac{1}{2}$–$\frac{3}{4}$ μ in diameter.

The interior tissue of the cane when diseased (and the disease appeared within only where the stalk had been wounded) was uniformly colored in specimens examined by us. We found in no case colored fibro-vascular bundles surrounded by white tissue. Dr. Comes found the fibro-vascular bundles either light yellow or highly colored and surrounded by white tissue.

The disease in Italy was found in the saccharine sorghum, presumably *Sorghum saccharatum;* that which we studied is in *Sorghum vulgare*, and so far as known to us at present does not occur on *Sorghum saccharatum*.

Finally we observe that the symptoms of the sorghum disease reported by Dr. Comes do bear, at least superficially, a marked resemblance to sorghum blight studied by us, yet at the same time the microbes appear to be quite different. At any rate a fuller diagnosis, showing more points of resemblance, may perhaps reasonably be expected in order to establish the identity of the disease occurring in Italy and in the United States.

NOTE BY T. J. BURRILL.

Through the kindness of Professor Kellerman I have had an opportunity to examine the manuscript by himself and Mr. Swingle in reply to the respectful claim of priority on the part of Dr. Comes in the matter of sorghum blight. The reply seems to me well made and fairly states the case upon both sides. I will here say that I had seen the notice in the *Botanisches Centralblatt*, XXIII. 19 (1885), before my first paper upon the subject was published, and really intended to refer to it. However, it seemed certain to me that the disease there alluded to could not be that with which I was engaged. This certainty was the primary cause of the omission of my intended reference, since I filed my note made at the time of reading the article among those of general plant diseases instead of among those due to bacteria, and thus overlooked it when the manuscript was prepared. Further, the tissues of growing sorghum plants are very likely to turn red when injured in any way, even by mechanical wounds, while the fact that alcohol was cited as a product and a *Saccharomycetes* as an agent clearly separated the characteristics of the diseases studied. It is certain that alcohol is not found directly connected with what is called sorghum blight in America. It seems to me impossible that any one could mistake the organism described as the cause of this last for either *Bacterium termo* or *Clostridium butyricum*, not to speak of a *Saccharomycetes*.

However, if this sorghum blight was really investigated in Italy before it was in America, no one will more cheerfully accept the fact than myself whether or not the authors properly described what they saw.

ROOT FUNGUS OF NEW ZEALAND.

By R. ALLAN WIGHT.

See Bot. Centralbl. LXV. 413

This fungus in the mycelial stage attacks a great variety of tree roots, amongst the most conspicuous of which are the apple, pear, peach, and all other common orchard trees. The white thorn is also very subject to its attacks, as well as a great many *Abies* and several of the native trees and plants. It also attacks the cabbage, the potato, docks, sorrel, fern, and in fact is almost omnivorous, which is a marked peculiarity.

The only plants I have ever known to resist it are resinous pines and roses; the former suffer at first and the leaves turn yellow, but they ultimately recover, and I never knew one to succumb, whereas the contrary is the case with all other plants attacked.

In hedges of white thorn where roses have been planted at intervals, the thorns are killed and the roses remain intact and quite uninjured. In an orchard it will appear in patches, killing the fern and sorrel and spreading until it reaches a fruit tree; it then attacks the bark round the stem just under the ground, which speedily rots, presenting the appearance of having been cooked, and has an offensive smell; it then proceeds along the roots and the tree soon shows withered leaves, which drop off, leaving it bare, and by and by it falls over and lies on the ground. Its movements are uncertain; sometimes a tree here and there dies; sometimes a whole row and very often acres are swept off. Many entire orchards of fine trees are killed in a few years. This fungus is never found in clay or other damp soils, but always in dry friable lands. Professor Kirk of Wellington says it is *Lycoperdon gemmatum*, Batsch., and that "tar water" is a certain cure. The last statement is assuredly an error, and I think the first is also. For a great many years I have endeavored in vain to procure the fruit of this fungus, using all the means that suggested themselves to me, without any success. I have seen large quantities of the *L. gemmatum* growing in orchards where there is no root fungus, and I have seen a very great many orchards and watched several closely where hundreds of trees are attacked and could never find the mycelium connected with the *Lycoperdon.*

The pest is most plentiful on the skirts of the primeval forests and on fern lands adjoining where no cultivation has ever been resorted to. Whole crops of potatoes are destroyed on such lands, and on dry lands where native tree stumps remain it is very prevalent. My own opinion is that it is a fungus native to and probably peculiar to New Zealand (in the North Island only). All my experiments with sulphur and lime have failed. Kerosene-oil used in winter has alone been of any use, and that has been used pure in winter without killing the tree. The fungi of New Zealand are legion and very destructive, but this is the worst, and particularly as it is confined to dry soils. Where I am now writing 500 trees have been killed within the last two years, and all remedies tried have failed. The apple-scab, the shot-hole fungus, the oidium of the vine are terrible pests in New Zealand, and the settlers have more to to fear from fungous growths than insect pests.

AUKLAND, NEW ZEALAND.

SOME NOTES UPON ECONOMIC PERONOSPOREÆ FOR 1889 IN NEW JERSEY.

By Byron D. Halsted.

Early in the season as announced in the *Botanical Gazette* for June, page 152, a peronospora was found upon cucumber leaves growing under glass here in New Brunswick. The disease assumed a violent form, and in the course of a few weeks all the vines were dead. Squash seed was afterwards sown in the same bed to determine whether the peronospora would develop upon this near relative of the cucumber. In the meantime the mildew, which seemed to be new, was studied; the method of germination by zoospores, and other points were determined and specimens with drawings were afterward sent to Dr. Farlow.

An account of this peronospora was given by Dr. Farlow in the *Botanical Gazette* for August, page 189, in which it was stated that the same species had been found a few months before in Japan, and that it was *Peronospora Cubensis*, B. & C., first found in Cuba on *Cucurbitaceæ*, and described several years ago.

Leaving aside the interesting fact of the widely separated points where this fungus has been found the readers attention is called to the economic side of the question, for not only were the squash leaves of plants growing in the hot-bed infected, but squash and pumpkin vines in various parts of the State were seriously attacked. The writer made it a point to look for this mildew as he visited various counties, and in all cases it was met with, and in some instances was so abundant as to discolor and destroy the leaves before they had attained full size.

The squash plant, from its habit of growing horizontally upon the ground and bearing large, widely separated leaves, is an easy one upon which to study the development of this fungus. It was never found upon the young leaves, but it followed some distance after and became manifest, for example, upon the fourth or fifth leaf from the extremity of the vine. The greenish yellow patches are first seen, and these are small and irregular in shape, being bounded by the veinlets. The spores are borne upon the under side of these patches and when mature are remarkably dark in color. This color is much darker upon the squash than the cucumber, and there are other differences which would be amply sufficient to warrant a varietal name if it was not evident from the hot-bed experiment that the differences are very probably entirely due to the influence of the host. During another season, should this pest return, it is hoped that other experiments will be made to determine more fully the habits of this fungus. As yet no oospores have been found. It should also be said that the attacks of this peronospora upon the cucumber were not confined to those growing under glass, but instead almost ruined some large fields of this plant. From the fact

that this fungus is closely related to the downy mildew of the grape it is safe to conclude that an occasional spraying of the vines with either the Bordeaux mixture or the ammoniacal solution of copper carbonate would prove an effective remedy. The only difficulty will be experienced in getting the liquid upon the under surface of the leaves, where it should lodge to be of most value. It remains to be seen whether the peronospora will attack and damage the water-melon, musk-melon, citron, and other cucurbitaceous plants related to the pumpkin, squash, and cucumber.

The potato rot (*Phytophthora infestans*, DBy.) has been unusually abundant in New Jersey, so much so that many large potato-growers have secured only a small fraction of a crop. The exceptional season has been a hard blow to the rot-proof theory that some "potato-seed" dealers have advanced. As far as observed there has been no one sort of potato that failed to be attacked when the conditions of moisture, warmth, etc., were most favorable. Apparently healthy potatoes secured from areas where most of the tubers have decayed show the threads of the fungus in the tissue, and especially in that portion in the vicinity of the eyes. Many farmers are still to be convinced that there is any danger in using such potatoes for the next season's planting.

In July some of the vines of *Ampelopsis veitchii*, commonly known as the Boston ivy, were found infested with a peronospora, that proved upon examination to be the *P. viticola*, DBy., so prevalent upon the cultivated grapes. Only a few plants out of many hundreds that are to be found in this vicinity were attacked, and all of these were young vines. In no case was any long petioled or divided leaf found with the mildew. The upper and exposed side of the infested leaves became prematurely bright-colored over the attacked portion; while beneath, the conidiphores were short, quite evenly set, and when the spores were mature the characteristic frosty appearance prevailed. It is evident that this is not a favorite host for the peronospora, and in ordinary seasons the vines will very likely not suffer from it. The native species of ampelopsis (*A. quinquefolia*) was often found near mildewed plants of the Boston ivy, but in no case was any of the fungus found upon this. It is, however, a well-known host.

The last peronospora of the season is that of the cultivated violet, (*V. odorata*), and was found upon leaves sent to the station by a grower of violets for the New York market, who claims that his crop is a failure and the loss is hundreds of dollars. A comparison of this peronospora was made with *P. violæ*, DBy., as found upon *Viola tricolor* var. *arvense* and distributed in Ellis' N. A. F. (No. 2207). The latter is placed among the species with dichotomous (uniformly forking into two parts) branching of the spore-bearing threads. In the form upon *V. odorata* there is no indication of this form, but instead it is quite like the mildew upon the grape in the manner of bearing the spores. Again, the spores of the two are different in size, shape, and color. It is true

that the size and color differences may be due to age, but in the *P. violæ* proper the spores are ellipsoidal, while in the other they are nearly perfect spheres. No oospores have yet been found. Whether it proves to be the same species or not, and that can be settled probably by cultures, the fact remains that one of our choicest of hot-bed plants is attacked by a mildew that from its destruction attracts the attention of the violet grower and should be treated with fungicides. A weak solution of the ammoniacal carbonate of copper would be likely to prove an effective remedy.

Among the species of cystopus, all of which have been abundant, only one need be mentioned here. The search, among students of this genus, for the oospores of *Cystopus ipomææ-panduranæ*, Schw. (*C. Convolvulacearum*, Otth.) upon wild sweet potato, or Man-of-the-Earth (*Ipomœa pandurata*), a miserable weed with enormous roots, has been prolonged and was rewarded only recently, as stated by Dr. Farlow in *Botanical Gazette* for August, page 187. This fungus was abundant in some parts of the State this year, doing valiant work in helping to destroy a pest in cultivated grounds. In some cases the enlargements of the stem where the oospores are borne in great numbers were many times the normal size. The particular point, however, in mentioning the species here is to announce that the leaves were found distorted, and in these thickened points the oospores abound.

It may be said in closing, that strange distortions of the flower stalks of wild mustard were met with this season, which were due to the growth within of another member of the same genus as above mentioned. It also works striking modifications of the flowers and fruit of the cultivated radish, which are often observed by truckmen who let this plant go to seed.

PREVALENCE OF ERGOT IN 1889.

By Erwin F. Smith.

Claviceps purpurea, (Fr.) Tul. was unusually prevalent along the east shore of Lake Michigan in the summer of 1889. At South Haven and St. Joseph I saw it in every rye-field, and it was so abundant that it could be gathered by the handful. Even scattering patches of rye in orchards, meadows, and along roadsides were infected. The best developed sclerotia were two inches long, but where a half dozen or more grew from one head they were smaller. In that part of the country it has been customary for some years to grow rye in the peach orchards as a green manure. It is sown in the autumn and ploughed down in the spring, but some portion of the crop always escapes the plow and comes to maturity. Moreover, through neglect or for other reasons, the rye is not always turned under green, so that the soil may be

assumed to be infected by sclerotia each year. Another favoring condition was an unusually rainy season, April, May, and June being very wet.

The same month (July) I carefully examined a number of large rye-fields in the central part of the State, where the spring was also wet, but where rye is not commonly cultivated, nor ever twice in succession on the same field, the result being that I could not find a single sclerotium.

It would be interesting to know whether ergot was abundant in other parts of the country, particularly along the Atlantic coast, where the rainfall was very heavy, 1889 being one of the wettest seasons on record.

AN EXPERIMENT IN THE TREATMENT OF BLACK-ROT OF THE GRAPE.

By B. T. Galloway.

Despite the fact that black-rot has ravaged the vineyards of this country for more than a quarter of a century, no systematic attempt, aside from bagging the fruit, was made to combat it until within the past three years. It is true that numerous "remedies" were proposed for the disease, but in no case had any of them stood the test of a thorough trial.

Bagging the fruit as a means of preventing rot first began to be extensively practiced something like ten or a dozen years ago, and there is no doubt that when properly done it is still the safest and most trustworthy means of saving the fruit. The only drawback to bagging is the cost, which must necessarily be considerable, as each bunch, in order to be made secure, is first bagged, then the bag is fastened, and finally, when the fruit is gathered, the bags must be removed. All of this of course consumes time, and time is money in this case as well as in any other. Where a man has a few choice varieties that he wishes to preserve for table use it would probably pay him to bag the fruit; but if he is a large grower, using his crop for wine, the impracticability of such a plan will at once become apparent.

At the time bagging first began to be practiced, grape-growers, as a rule, recognized the fact that black-rot was a fungous disease, due to outside influences, and not brought about by any morbid conditions of the plant. At first it was the practice to put on the bags as soon as the first rot specks appeared; but experience soon demonstrated that to preserve the fruit it was necessary to inclose the clusters shortly after the flowers opened.

In order to settle definitely the cause of rot and if possible to provide a remedy, this Department began an investigation of the subject in 1886. It is not necessary here to go into the details of this work, it being sufficient for our purpose to say that it was proved beyond question that the malady was caused by a parasitic fungus growing within

the tissues of the berry, that this parasite was propagated by minute spores which were at all times present in the vineyard only awaiting suitable conditions of moisture and heat and contact with the growing fruit to cause infection. These facts once demonstrated it was readily understood why bagging prevented the rot, as by that process the spores were simply excluded and infection thereby made impossible. Having reached this stage of the investigation, the question arose as to whether there was not some substance or substances which if applied to the fruit would prevent the spores from germinating or destroy them entirely, thereby preventing infection in practically the same manner as with the bags.

The questions to be considered in this connection were numerous and difficult of solution. It was necessary that the substance employed should not injure the fruit or foliage, that it should be cheap, easily applied, and above all things practicable, and, finally, that it should not render the fruit unfit for eating or wine-making. The good results obtained in treating mildew with the sulphate of copper compounds was a sufficient reason for giving these preparations a thorough trial for black-rot. Accordingly the first systematic experiments, made with a view of determining the value of the copper remedies for the disease, were undertaken in the summer of 1887. The experiments were made over a very wide area, and, while the results were by no means conclusive, they were of such a nature as to warrant a further continuance of the treatment.

In 1888 the experiments were repeated on a more extended scale, and as a result it was demonstrated beyond question that in a favorable or even ordinary season from 40 to 60 per cent. of the crop could be saved from rot. These trials also showed that of all the preparations used the Bordeaux mixture, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water, yielded the best results. It was further demonstrated that the applications to be successful must be applied *early;* in fact this was to be expected from what was already known concerning the proper time for bagging the fruit.

This year among other things we planned an experiment designed to throw some additional light on a number of questions in connection with the treatment of black-rot; chief among them were the following:

(1) A comparison of the actual cost and results of the treatment, using the preparations known as eau celeste, Bordeaux mixture, and the ammoniacal solution of carbonate of copper.

(2) The proper strengths of the preparations, i. e. the strength which would give the best results.

(3) The proper time to apply the remedies.

(4) The effect of winter treatment, *i. e.* spraying the vines before the leaves start.

The vineyard selected for the work was situated near Eastham, Va., and was the property of Mr. A. L. Holladay, who, it is proper to state,

conducted all the experiments from beginning to end. The vineyard, of about 2½ acres, contained something over 1,400 Norton vines, these being in their tenth year. This area was divided into sixteen sections; but as two of these were treated with remedies with which we are not at present concerned, they will be omitted altogether. The fourteen sections were treated as follows:

Section 1.—Bordeaux mixture *a*, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water.

Section 2.—Eau celeste, containing 1 pound of sulphate of copper, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 3.—No treatment.

Section 4.—Bordeaux mixture *b*, containing 4 pounds of sulphate of copper, 2 pounds of lime, and 22 gallons of water.

Section 5.—Eau celeste *b*, containing 2 pounds of sulphate of copper, 2 pounds of carbonate of soda, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 6.—No treatment.

Section 7.—Ammoniacal solution of carbonate of copper, containing carbonate of copper 3 ounces, aqua ammonia 1 quart, water 22 gallons.

Section 8.—Bordeaux mixture *a*, applied in a different part of the vineyard from section 1.

Section 9.—No treatment.

Section 10.—Bordeaux mixture *b*, applied in a part of the vineyard remote from section 4.

Section 11.—Bordeaux mixture *a*, applied some distance from 1 and 8.

Section 12.—Bordeaux mixture *c*, containing copper two pounds, lime 1 pound, water 22 gallons.

Section 13.—Ammoniacal solution of carbonate of copper applied at some distance from section 7.

Section 14.—Bordeaux mixture *d*, containing 3 pounds of sulphate of copper, 1 pound of lime, and 22 gallons of water.

Sections 10 and 11.—Were treated in March with a simple solution of sulphate of copper, 1 pound of the copper to 25 gallons of water.

With the exception of 8 all the sections were sprayed the first time on May 18, the second on June 3, third on July 23, fourth on August 3, and fifth on August 16. Section 8 received its first application on the 6th of June, this being the experiment designed to test the effect of late spraying. On the 1st of October the fruit on all the sections was gathered and carefully weighed, with the following results:

Section.	No. of vines.	Total yield.	Average yield per vine.	Section.	No. of vines.	Total yield.	Average yield per vine.
		Pounds.	*Pounds.*			*Pounds.*	*Pounds.*
1	120	307¾	2.56	8	92	158¼	1.72
2	122	393½	3.22	9	17	17	1
3	20	20	1	10	146	470	3.21
4	163	357¾	2.19	11	165	574	3.48
5	99	236¾	2.39	12	23	52	2.26
6	21	11¾	.56	13	108	159	1.48
7	108	159	1.48	14	114	336	2.94

Now, in regard to the cost, the chemicals were all purchased at wholesale rates, as follows:

Sulphate of copper	per pound..	$0.06½
Best lime	per barrel..	1.25
Aqua ammonia	per pound..	0.05
Carbonate of copper, concentrated solution	per quart..	0.16⅔

Using the Japy pump and Vermorel nozzle, it is estimated that the cost of labor in applying the remedies was $2.50 per acre for five applications, or one-half a cent per vine. The number of gallons of the various solutions used per acre was, on an average, 44. Taking these figures as a basis, we have the total cost of treating the various sections as follows:

Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.	Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.
			Cents					*Cents*	
1	120	$1.61	1.3	$6.70	8	92	$1.23	1.3	$6.70
2	122	.95	.8	4.90	9	Proof.			
3	Proof.				10	146	1.47	1.0	5.29
4	163	1.71	1.0	5.25	11	165	2.23	1.3	6.70
5	99	1.15	1.2	5.80	12	23	.17	.8	4.00
6	Proof.				13	108	.90	.8	4.00
7	108	.90	.8	4.00	14	114	1.04	.9	4.55

It is seen from the foregoing tables that the largest yield per vine (3.48 pounds) is in section 11, where the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime, was used. This section also received the winter treatment. By comparing this yield with that of section 1, where the same mixture was used but the winter treatment omitted, it is seen that there is a gain in favor of the winter-treated section of nearly a pound per vine. Now examine the figures in section 4, treated with the Bordeaux mixture, containing 4 pounds of copper

sulphate and 2 pounds of lime, and it will be seen that the yield per vine is 2.19 pounds. In section 10, treated in exactly the same way, with the addition of one winter spraying with the simple solution of sulphate of copper, the yield is 3.21 pounds, a gain of more than a pound per vine. This certainly indicates that the winter treatment in this case resulted beneficially, but whether the same will hold true everywhere we are not prepared to say. Assuming that it does, however, let us, on the basis of the figures here given, estimate the cost of treating an acre of vines and compare the yield with that of an acre not treated.

Let us suppose that A owns a vineyard of 1 acre and that his neighbor, B, is the possessor of a similar number of vines of the same variety. A treats his vineyard six times, as follows:

March 20, sprayed with a simple solution of sulphate of copper, 1 pound to 25 gallons, at a total cost of 65 cents. May 18, June 7, July 23, August 5, and August 16, sprayed with the Bordeaux mixture, containing 6 pounds of sulphate of copper, 4 pounds of lime to 22 gallons of water, at a total cost of \$6.70, which, upon adding the 65 cents for first spraying, becomes \$7.35.

B makes no treatment whatever, consequently saves the \$7.35. A's vineyard of 500 vines yields $3\frac{1}{2}$ pounds per vine, or 1,750 pounds for the whole, which, at 3 cents per pound, equals \$52.50.

B's vineyard yields 500 pounds, or 1 pound per vine, valued at 3 cents per pound, or, for the whole, \$15. Summing up the results we have the following:

A.

By treatment of vineyard	\$7.35
Yield of grapes, 1,750 pounds, at 3 cents per pound	52.50
Balance	45.15

B.

No treatment.	
Yield of grapes, 500 pounds, at 3 cents per pound	15.00
Difference in favor of A	30.15

Turning again to the table we notice that section 2, treated with eau celeste containing 1 pound of copper sulphate and $1\frac{1}{2}$ pints of ammonia to 22 gallons of water, yielded 3.22 pounds per vine. This is indeed a very good showing, but as this preparation, unless used with extreme caution, is certain to burn the foliage its use can not be advised.

The conclusions which we draw from the foregoing may be briefly summed up as follows:

(1) It pays to treat the vines for black-rot.

(2) The best preventive, all things considered, is the Bordeaux mixture, containing 6 pounds of copper sulphate, 4 pounds of lime to 22 gallons of water.

(3) As the amount of copper in the Bordeaux mixture is decreased its value as a preventive is lessened.

(4) The application of the Bordeaux mixture should in all cases begin early, *i. e.*, about the time the flowers are opening.

(5) Spraying the vines before the leaves start with the simple solution of sulphate of copper is decidedly beneficial.*

ERYSIPHEÆ UPON PHYTOPTUS DISTORTIONS.

By F. W. Anderson and F. D. Kelsey.

Dr. Byron D. Halsted's note on *Sphærotheca* on Phytoptus distortions in the September Journal is interesting, and concludes by asking; "Have other Phytoptus growths been found infested with members of *Erysipheæ ?*" So far as observations on the subject go in Montana an affirmative answer might be returned. In the article on Montana *Erysipheæ* in this number of the Journal by one of the writers, mention is made of *Sphærotheca Castagnei*, Lév. on *Shepherdia argentea* (Bull or Buffalo Berry), on *Geranium incisum*, and on *Erigeron Canadense;* also of *Sphærotheca mors-uvæ*, (Schw.) B. & C. on *Ribes rotundifolium;* the former fungus on *Shepherdia* and the latter fungus on *Ribes* were associated with the mites, and the peculiar powdery coating caused by these creatures in places almost covered the fungus. In both cases the distorted leaf axils, abnormally developed buds, and thickened brittle upper leaves bore the perithecia of largest size and in greatest numbers, leading us to the same natural conclusion as was formed in the mind of Dr. Halsted regarding the benefit received by the fungus through the unusual softening of the host tissues. Like him, too, we observed that on those portions of the host unaffected by the mite the fungus was only in an ordinary degree of development for that time of the year [July 10 for *S. Castagnei*, Lév., and June 8, or 9, for *S. mors-uvæ*, (Schw.) B. & C.]

On the *Geranium incisum* occurred also some mite together with the *S. Castagnei*, Lév., and again the fungus seemed to be more richly developed on the doubly affected parts. Late in the season the same fungus was found on *Erigeron Canadense*, and growing side by side with this host were plants of *Epilobium coloratum* badly affected by a mite, and the conidial form of an *Erysipheæ* which seemed to be *Sphærotheca Castagnei*, although no positive determination could be reached. On *Oxytropis Lamberti*, *Astragalus triphyllus*, and *Astragalus adsurgens*, *Erysiphe communis*, (Wallr.) Fr., has been frequently seen in company with a mite; while *Erysiphe cichoracearum*, DC., may be found at almost any time during the summer in connection with mites on *Chrysopsis villosa*, *Helianthus* (several species), *Cnicus undulatus*, *Erigeron macranthus*, and *Mertensia Sibirica*. In every case where these forms of animal

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*Applicable only to this experiment.

and vegetable life are so associated there is a more vigorous development and more early maturing of the fungus than under ordinary circumstances. Let us hear from others on this interesting subject.

TREATMENT OF APPLE SCAB.

By B. T. Galloway and E. A. Southworth.

In May of last spring arrangements were made with the experiment stations of Michigan and Wisconsin to carry on a series of experiments for the purpose of finding a remedy for Apple Scab (*Fusicladium dendriticum*, Fckl.).

The fields of experiment were located at Lansing, Mich., on the College Farm, and at Ithaca, Richland County, Wis.; the work at the former place being under the direction of Professor Taft, Horticulturist of the College and Experiment Station, and at the latter under the general supervision of Professor E. S. Goff, Horticulturist of the Wisconsin Experiment Station, and in direct charge of Mr. A. L. Hatch, of Ithaca.

The season was a favorable one, as the weather was wet enough to favor the growth of the fungus and thus offered a fair test of the remedies employed.

The plan of work was drawn up at this Department and the same outline for the experiments was given to both. The instructions were very carefully carried out, and both experimenters have been unremitting in their diligence in making the applications and preserving accurate accounts of the results.

The fungicides used were sulphide of potassium, hyposulphite of soda, a soluble sulphur powder prepared by Mr. E. Bean, Jacksonville, Fla., ammoniacal solution of copper carbonate, and modified eau celeste. Professor Goff, however, did not use the eau celeste.

Both made seven applications; Professor Goff beginning May 18, and Professor Taft May 24, when the apples were about the size of peas and before any trace of scab was apparent. In regard to the time of beginning, Mr. Hatch says he is convinced that the applications should be started earlier, as he thinks fungus activity begins with the swelling of the buds. The varieties treated were the Northern Spy, by Professor Taft, and the Fameuse, by Professor Goff; both selected because they had been particularly troubled by scab previous to the present year.

With regard to the strength of the solutions employed, Professor Taft and Professor Goff both used the potassium sulphide in the proportions of one-half ounce to the gallon of water. The hyposulphite was used in both cases at the rate of 1 pound to 10 gallons. Professor Goff records some injury to the leaves from this strength, and on the fifth applica-

tion Professor Taft reduced the solutions, using 1 pound to 12 gallons, after which he says there was no further injury to the foliage.

The soluble sulphur powder was used in the proportion of 1 pound to 10 gallons of water, but Professor Taft was not able to make the first application until June 6. Mr Bean also sent Professor Goff a concentrated solution of the powder, which was diluted and used for three applications to two trees, after which he was obliged to stop because he had exhausted the supply and received no more.

The copper carbonate was prepared differently by the two. Professor Taft used the usual formula, 3 ounces of copper carbonate dissolved in 1 quart of ammonia and the whole diluted to 22 gallons. It was used at this strength throughout the experiment, but produced a russet appearance on the fruit, and he recommends that it should be diluted to 28 instead of 22 gallons.

Professor Goff procured the copper carbonate by precipitating it with carbonate of soda from a solution of copper sulphate. He found that only 1⅛ ounces of the dried precipitate would dissolve in 1 quart of ammonia, and to this he added 90 parts water. At the sixth spraying (July 24) he observed that the apples had assumed a russet appearance from some injury to the epidermis. For the sixth and seventh spraying he reduced it one-half, that is diluted it 180 times.

Professor Taft prepared the eau celeste as follows: He dissolved 2 pounds of copper sulphate in hot water, and in another vessel dissolved 2½ pounds carbonate of soda; the two were mixed and diluted to 22 gallons, 1½ pints of ammonia being added before using. This also gave a russet appearance to the fruit, and he recommends the use of 30 or 32 gallons of water instead of 22.

On the sixth application Professor Taft only sprayed one tree with each solution, leaving one unsprayed in each case. He made the last application August 1, and Mr. Hatch made the last application for Professor Goff on August 10.

Results.—The copper solutions remained persistently on the leaves, even resisting heavy showers which washed off all traces of the sulphur compounds, and when the leaves fell in October traces of copper could still be seen on them.

Scab was first noted at Lansing on the fourth application, June 25, when it had made its appearance on all the trees, but was noticeably less on those sprayed with the copper solutions, and less on the other treated trees than on the untreated ones.

At time of harvesting Professor Taft picked all the apples on the trees and assorted them into three lots, of first, second, and third quality. The first class contained those free from scab, the second those slightly scabby but not distorted or under size, the third those that were distorted or under size. Those in each class were counted and the percentage which they formed of the whole estimated.

At Ithaca, Wis., the apples were not all picked, but a market-basket

holding about 1½ pecks was first filled with apples from the lowest branches of one of the trees. Next a similar basketful was picked from the branches that were just the height one could conveniently reach, taking care to pass clear around the tree in both cases. After this a basket of one-half a bushel was filled from the tallest branches of the tree. The apples were then poured upon an assorting table; and the baskets filled and emptied again in the same manner and from the same tree, after which the contents of the six basketfuls were assorted into three qualities as in the preceding case.

The results in both cases are embodied in the following table:

	Professor Goff's experiments.					Professor Taft's experiments.					
	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Total yield.
		Per cent.	*Per cent.*	*Per cent.*	*Cts.*		*Per cent.*	*Per cent.*	*Per cent.*	*Cts.*	*Pounds.*
Potassium sulphide	7	30.04	48.55	21.41	37	7	25.5	74.3	.2	39	1,615¼
Sodium hyposulphite....	7	43.24	42.78	13.98	29	7	23.6	75.4	.89	23	1,648
Sulphur powder.	7	32.72	54.31	12.97	31	6	17.6	81.2	1.1	31	1,435¼
Am'l copper carbonate ..	7	75.02	23.35	1.63	38	7	51.2	48.6	.16	49	2,112¾
Eau celeste..............	......	......	......	....	......	7	68.8	31.0	.2	60	1,675½
Sulphur solution	3	42.9	48.99	8.11	......	......	......	......	......	......	....
Unsprayed	......	23.34	53.89	22.71	......	......	12.5	85.7	1.8	.....	769¼

It will be seen that at both places there is a very decided showing in favor of the copper solutions. Professor Goff did not try the eau celeste, and this produced the best results for Professor Taft, giving 68.8 per cent. entirely free from scab. One of the trees produced 88 per cent. free from scab, the other was heavily loaded and gave 59 per cent. The two sets of results agree as to the main point but show some striking differences. It is probable that these are partly owing to different localities, varieties treated, and varying conditions of weather, and very likely in great measure to different ideas of the two experimenters as regards the three classes into which the apples were assorted. In many cases it would be a question as to which of two classes an apple should belong.

By comparing the two tables it is evident that the badly scabby apples were more numerous in Mr. Hatch's orchard, while those of the second quality preponderated on the college farm.

Professor Goff obtained the best results with the ammoniacal copper carbonate solution, thereby keeping 75.02 per cent. free from scab against 51.2 per cent. by Professor Taft. There is, however, about the same per cent. of badly scabby apples in both cases. Professor Goff's results with this are even better than Professor Taft's with eau celeste, except that the badly scabby apples were over 1 per cent. greater with the

former. The most striking difference in the results, however, is in case of the sulphur powder. With Professor Goff it ranked ahead of the potassium sulphide, and as regards amount of badly scabby apples, ahead of the sodium hyposulphite, while with Professor Taft it fell behind both. The solution of the powder which was prepared by Mr. Bean, although applied but three times, completely preserved 42.9 per cent. of the fruits from scab against 23.34 per cent. on the unsprayed trees, a very good showing under unfavorable conditions. With Professor Goff sodium hyposulphite succeeded better than potassium sulphide, while the contrary was true with Professor Taft, although the difference is not marked in either case.

Aside, however, from these minor differences, it is evident from the tables that the sprayed trees, especially those sprayed by copper compounds, produced a much larger percentage of healthy fruit than the unsprayed. The greatest difference between the perfect fruit on sprayed and unsprayed trees under Professor Goff's charge was 51.68 per cent. and the least 6.7 per cent. The greatest difference in those under Professor Taft's charge is 56.3 per cent. and the least 5.1 per cent., the two results being essentially the same.

Besides the tabulated results there were others which are of great importance but can not be estimated in exact figures. A scabby apple is much smaller than a healthy one, and in many cases, while the apples could not be placed in class one, the scab had so been held in check that the fruit had obtained a greater size than it otherwise would. Professor Taft gives the difference in weight between perfect and scabby fruits as varying from .037 to .002 pound for each apple, and says the scabby apples are 10 per cent. smaller than the perfect ones, making a difference of nearly a bushel per tree in size alone, besides the fact that the apples that are badly scabby are unmarketable. "From the combined effect of the two causes," he says "we lost on some trees a barrel of apples."

The cost of the chemicals and labor expended varied but slightly in the two cases, but both gentlemen were obliged to buy chemicals in small amounts, and the cost per tree would be greatly lessened by treating a large orchard and buying materials in quantity. Professor Taft used large trees requiring 3 gallons each for each application, while Professor Goff used 3 gallons for the two trees, but Professor Goff estimates the labor higher than Professor Taft, and this makes the figures nearly alike. Both these estimates, however, are for seven applications. In an average season, and with the copper solutions, four or at most five applications will probably be sufficient. It is likely that in a large orchard with average sized trees, when the chemicals were purchased by the quantity the expense could be reduced nearly one-half. The expense of the ammoniacal solution in particular would be reduced by purchasing the copper carbonate instead of preparing it from the sulphate.

In Mr. Goff's calculations the cost for labor in making the treatments amounts to more than half the expense.

It seems probable that it would be profitable to make the first application earlier than was done this year, and there is no reason why this application or the next should not be combined with London Purple or some other insecticide, and the tree protected from insects and fungi at the same time. Mr. Hatch closes his report thus:

What we now need is to determine the correct amount of the copper mixture to use, the times best suited to its application, and what combinations to make with insecticides, and a new era in fruit culture will be inaugurated.

NOTES.

By B. T. Galloway.

POWDERY MILDEW OF THE BEAN.

Under date of December 13 Mr. C. N. McCallan, of St. George's, Bermuda, writes that on the 20th of November his section was visited by a very heavy fog, and a few days later he noticed that his crop of six-weeks beans was badly mildewed, the fungus being one of the *Erysipheæ*, probably *Erysiphe communis*, Lév. He immediately gave the plants a thorough dusting with flowers of sulphur, and in a week the fungus had entirely disappeared and the plants produced a good crop. Mr. McCallan was highly pleased with this result, as he has several times lost his entire crop of beans from the attacks of the same fungus. In this country, peas, especially those planted late in the season, are often attacked by mildew, which in all probability might be easliy prevented by the timely application of flowers of sulphur or some other fungicide. A powder made by mixing equal parts of air-slaked lime and flowers of sulphur will be found a very good remedy for this disease. The powder should be dusted on the foliage at the first appear ance of mildew and the operation repeated every ten or twelve days, or more often if there is an abundance of rain.

If one has a spraying machine a solution made by dissolving 3 ounces of carbonate of copper in 2 quarts of aqua ammonia diluted to 22 gallons will be found an efficient remedy against mildew. This solution should be applied every twelve or fifteen days, beginning at the first appearance of the disease. Three ounces of carbonate of copper can be bought for 10 cents, while the ammonia will cost about 10, making the total cost of the 22 gallons 20 cents; certainly a very cheap fungicide. If carbonate of copper is not obtainable it may easily be prepared by first dissolving sulphate of copper (blue stone) in water and then adding ordinary washing soda. The precipitate formed on the addition of the latter substance is carbonate of copper, and in order to obtain it the liquid only needs to be drawn off and the copper carbonate dried.

RUST OF FLAX.

A short time ago we received from Mr. Frazier S. Crawford, of Adelaide, South Australia, some specimens of flax affected with a fungus, which upon examination proved to be *Melampsora lini*, (DC.) Tul. Mr. Crawford wrote that the parasite had destroyed a crop of flax near Adelaide, and expressed the fear that it would spread and prove a troublesome pest. The fungus has long been known in Europe, where it has occasioned considerable trouble; but so far as we are aware it has not been found on cultivated flax in this country. This seems rather strange considering the fact that it occurs here on quite a number of our native species of *Linum;* but after all an explanation of this may be found in the fact that the fungus is as yet confined to regions where there is little or no cultivated flax grown. We have it from this country on the following hosts:

Linum Virginicum, Decorah, Iowa (Holway).

Linum perenne, Sand Coule, Mont. (Anderson). Flagstaff, Ariz.; and Palisade, Nev. (Tracy).

Linum Lewisii, Spring Hill, Mont. (Anderson).

Linum rigidum, Livingston, Mont. (Seymour).

Linum sulcatum, Armstrong, Iowa (Cratty).

We see no reason why this fungus, if once introduced, would not prove a serious pest to our flax-growers, and until it is shown that it will not attack this crop it would be well to look upon it with suspicion. We have under way some experiments designed to throw some light on the question as to whether the fungus from western hosts will attack cultivated flax, but it is yet too early to speak definitely in regard to them.

NECESSITY FOR A REDESCRIPTION OF THE TYPE SPECIES IN KEW HERBARIUM.

In another part of the present JOURNAL will be found an interesting paper on some of Berkeley's types, by George Massee of the Royal Herbarium, Kew, England. There are over seven thousand type specimens of fungi in the Kew Herbarium, but every mycologist knows that in the majority of cases the descriptions of these are so meager and the figures so inaccurate that it is absolutely impossible to use them in the determination of species. As a result species and even genera are constantly being redescribed as new, thereby adding to the confusion which already exists.

To avoid further trouble of this kind, and at the same time to preserve to the world the valuable material, which however well cared for will eventually through the ravages of time become worthless, it seems to us of the highest importance that the types should be described anew from our present stand-point of knowledge. Such a work, accompanied by good illustrations, would be of untold value to mycologists

everywhere, and we feel sure that we voice the sentiment of all workers in this field when we say that the Kew authorities could not render a better and more highly appreciated service than the carrying out of such an undertaking.

NEW LOCALITIES FOR PERONOSPORA CUBENSIS, B. & C.

In the *Botanical Gazette* for August, 1889, and on page 201 of the present JOURNAL, attention is called to this fungus, the localities for its occurrence being given as Cuba, Japan, and New Jersey. We have recently received it from Anona, Fla., and College Station, Tex. At the former place, according to our correspondent, it appeared in the early part of December and destroyed a large number of cucumber plants growing in the open air in a few days. At College Station it also occurred upon *Cucumis sativa*, but no account of the injury it occasioned was furnished. That it was abundant there, however, is evident from the fact that our correspondent sent us more than 150 good specimens and did not seem to have any trouble in getting them.

REVIEWS OF RECENT LITERATURE.

BEUCKER, GEORGES. *Traitement du Mildiou.* Le Progrès Agricole, 4 août 1889; *ibid.*, 1er septembre 1889.

These short reports coming from the French School of Agriculture recommend strongly to the use of viticulturists a fungicide which has hitherto not been used to any great extent in this country—verdigris, or basic copper acetate. In an experiment extending over three years this fungicide has proved to be, taking all its features into consideration, the most satisfactory among the copper compounds. The chemical itself being a mixture of the normal and bibasic acetates of copper is decomposed by the action of water, and the insoluble bibasic salt precipitated as a light jelly-like substance, which upon being sprayed upon the leaves dries and covers them with a hard horny layer. It is claimed for this solution, made by adding to 6 or 8 gallons of water at the ordinary temperature 2 to 4 pounds of the powdered verdigris and allowing it to stand twenty-four hours before diluting to 22 gallons, that it possesses in a much higher degree than the Bordeaux mixture the quality of adhesiveness, while lacking none of the latter's qualities as a preventive of mildew.

In the report of September the author answers many questions brought out by the former report of August in regard to the nature of the chemical and its proper application, giving in some detail a method for the home production of the basic acetate from the waste *marc*, or pumice of the grape, and small copper plates. The cost of the material is also carefully worked out, calculation being made for labor of

preparation by the home process. The conclusion reached shows a cost of only $2.25 per acre when the verdigris is of home manufacture. The question of danger in its use is answered by reference to analyses made of grapes sprayed with the mixture, showing only an infinitesimal quantity present in the wine, and also to the medical works of Dr. Pécholier and Saint Pierre, which go so far as to say that when taken in small doses the acetate has a decidedly beneficial influence upon the human system.

From the inexpensiveness of the material, 20 to 30 cents per pound, when it is remembered that only 5 to 6 pounds are sufficient to spray one acre, the ease with which it may be prepared and applied and its decided efficiency, evinced by such a series of experiments as are contained in these reports of Mr. George Beucker, it seems worthy at least of a thorough trial among the vineyards of this country.—DAVID G. FAIRCHILD.

DIETEL, DR. PAUL. *Ueber Rostpilze, deren Teleutosporen kurz nach ihrer Reife keimen.* Botanisches Centralblatt, 1889, Nos. 18–20.

Dr. Dietel attacks the well-known Lepto and Micro sections of the genera of the *Uredineæ* and says no such division can be made either on a morphological or biological basis. He cites examples of species belonging to other sections whose teleutospores also germinate immediately after ripening. He recommends instead of the Lepto and Micro sections one section whose distinguishing character should be the formation of teleutospores unaccompanied by any other form, and that this should have two subsections with the same distinguishing characters that now mark the two main ones.

The species belonging to the Lepto-section of the *Uredineæ* are discussed according to their hosts, and in many cases the union of species generally considered as distinct is suggested; among these suggestions are the following:

Puccinia malvastri, Pk., is undoubtedly identical with *P. sherardiana*, Korn., and the latter name, being the older, should be adopted. The group of *Uromyces* attacking the *Malvaceæ* should probably be much reduced in number, but at least one true *Lepto-uromyces* must exist.

Puccinia mesnieriana, Thum. on *Rhamnus alaternus* in Portugal is identical with *P. digitata* on *R. croceus* from California.

P. saxifragæ, Schlectd., *P. curtipes*, Howe, and *P. striata*, Cke., are probably identical, and *P. saxifragæ* is a *Lepto-puccinia.*

P. chrysosplenii, Grev., *P. spreta*, Pk., and *P. congregata*, E. & H. differ only in minor points, so that it is impossible to consider these species with which *P. tiarellæ*, B. & C., and *P. heucheræ*, Sch., should probably be included as strongly distinct from each other.

He considers *P. asteris* as the type of *Puccinia* on *Compositæ* and notes the following as agreeing with it more or less perfectly: *P. vomica*, *P. serratulæ*, *P. subtecta*, *P. Printziæ*, *P. gerardii*, *P. xanthii*, *P. silphii*, and *P. grindeliæ.*

Conclusions.—The presence of *Uredineæ*, whose teleutospores germinate immediately after ripening, is not confined to certain families of Phanerogams, the *Liliaceæ*, *Gramineæ*, *Cyperaceæ*, and *Umbellifereæ* being the only families not represented among their hosts. Their presence does not seem to depend simply on the presence of host plants, but to be correlated with meteorological conditions. They are more abundant in high mountains and moist valleys, or on low land by rivers.—EFFIE A. SOUTHWORTH.

KELLERMAN AND SWINGLE. *Preliminary Report on Smut in Oats.* Bulletin 8. Experiment Station, Kansas State Agricultural College, 1889.

There has long been no doubt that wheat may be infected with smut by dusting the grain with spores, or by sowing it in soil in which the spores already exist. Consequently since the spores can pass uninjured through the intestines of cattle, it becomes a dangerous matter to use manure from stock that have had access to straw of smutted wheat. Since this is true for wheat, the natural inference is that it is also true for oats and barley. This has been questioned, however, and in 1888 in an article, already reviewed in this JOURNAL, Mr. J. L. Jensen gave very conclusive proof that grains still included in the husks at the time of planting could not be infected by spores which came in contact merely with the exterior of the husks, and consequently that spores in the manure or in the soil could have no effect on the amount of smut in the crop.

In the Bulletin above mentioned Professor Kellerman and his assistant, Mr. W. T. Swingle, give a full account of further conclusive experiments in the same direction. They have also included in their experiments a comparison of the value of sulphur and iron compounds against hot water as a dressing for seed grain.

An experiment to artificially infect oats when in blossom failed, but other experiments clearly established that the spores must be in or sticking to the seed when planted. Experiments in planting seed treated in different ways in untreated soil and soil which had been artifically manured, or smutted, or both, gave the following results: Soaking the seed in a solution of iron sulphate ($1\frac{1}{2}$ pounds per gallon) did not materially decrease the amount of smut or injure the grain; soaking the seed in copper sulphate solution (4 ounces to 1 gallon) eighteen hours prevented smut but lessened the fertility of the seed; treating seed with hot water (132° F.) for fifteen minutes prevented smut and improved rather than diminished the germinating powers of the seed and vigor of the plants; soil which had been treated with manure and smut the previous August actually gave a less per cent. of smut than untreated soil; soaking the seed eighteen hours in a 5 per cent. solution of concentrated lye prevented smut, but injured the seed; soaking eighteen hours in a 3 per cent. solution of sulphuric acid did not pre-

vent smut, while a 10 per cent. solution prevented smut and greatly injured the seed.

Natural enemies of smut.—Five different natural enemies of smut are described. A white mold, probably some species of *Fusarium*; a black mold, a new species of *Macrosporium*; a bacterial disease; and two smut-eating beetles.

The bulletin also contains a few preliminary notes on stinking smut, announcing that experiments are already under way to determine the comparative value of different fungicides in this case also.—EFFIE A. SOUTHWORTH.

KELSEY, F. D. *Study of Montana Erysipheæ.* Botanical Gazette, Vol. XIV. No. 11, p. 285.

This paper, prepared by Mr. Kelsey, contains a number of interesting notes upon nine species of *Erysipheæ* of Montana, a number of rare hosts being cited, and one provisional new species, *Erysiphe sepulta*, E. & E. on *Bigelovia graveolens.* This species is, however, acknowledged to resemble *E. chicoracearum*, DC. quite closely, a species widely variable upon the many hosts which it inhabits.—DAVID G. FAIRCHILD.

L'ECLUSE, A. DE. *Traitement du Black Rot.* Rapport à M. le Ministre de l'Agriculture. Le Progrès Agricole, October 13, 1889.

The results contained in this short report to the French minister of agriculture, while they present nothing strikingly new in the matter of treatment of black-rot, may be of interest to vine-growers and others as coming from a foreign experimenter. The author theorizes in the first part of the report among other things upon the ability of the fungicidal solutions to penetrate the conceptacles of the black-rot upon the leaves, taking it for granted that the leaf-spot and black-rot of the berries are identical. He believes it consequently almost useless to spray the berries simply without destroying the sources of infection found in the fungus of the leaves, and counsels spraying all the green surfaces of the vine as well as the grape clusters themselves. This to be done at least before the middle of May.

The report of the author's field experiments, in which the common fungicides seem to have been largely used, contains no new points either in matter of apparatus or mixtures, and is somewhat complicated, certain unexpected variations being explained by the ungovernable conditions so abundant in such work. Without discussing the details of the investigations or questioning particularly whether he is authorized in drawing such broad conclusions from only one year's experiments, it may be well to state briefly the author's opinions: That the efficacy of the copper compounds against black-rot is indisputable; that the disrepute into which they have fallen is due solely to misdirected use of them; that their action is at the same time preventive and curative if spread uniformly upon all green parts of the vine; and that the crop

gathered will be lighter as the applications are less perfectly made. In conclusion the writer adds:

I am happy to be able to say that the black-rot, which American viticulturists have considered with reason as the worst of diseases, is to-day a malady less difficult to guard against than the odium, the anthracnose, or the mildew.—DAVID G. FAIRCHILD.

PECK, CHARLES H. *Boleti of the United States.* Bulletin of the New York State Museum, Vol. II, No. 8, September, 1889.

In this bulletin Professor Peck brings together descriptions of all *Boleti* known to occur in the United States. Convenient synoptical tables have been arranged for the use of students, and the author seems to have done everything to make this a complete synopsis of the United States species of this important family. Western readers will at once notice that the Rocky Mountain regions are not cited in the geographical distribution of the species, and even California is only credited with a very few, the vast majority seeming to occur in the Eastern and Southern States. We would naturally inquire whether the *Boleti* have been carefully searched for by botanists in the Rockies, or whether there is a natural but deplorable dearth of such fungi in these regions. It is almost certain that from the western slopes of the Rocky Mountains many new and otherwise interesting *Boleti* will yet be reported, because on the western slopes the best natural conditions obtain for their development. It is possible, however, that the comparative lack of damp forests and copses on the eastern slopes, of the northern Rockies at least, may preclude the possibility of very many *Boleti* ever being found there, as the forests, though extensive, are neither very dense nor very humid.

In the paper before us 110 species are recorded, as against 100 species described in *Hymenomycetes Europæi.* Of the whole number 36 are natives of Europe as well as America. The author has found it necessary to establish two tribes not represented in European *Boleti,* as he remarks, "for the reception of species for which no place is found among the Friesian tribes." He has adopted Fries's classification in the main. He tells us that a few species have been left unclassified in consequence of the imperfect character of their descriptions, and that a few unpublished species have been omitted because they are as yet represented by too scanty material. The genera included in the paper are as follows: BOLETINUS—5 species. This genus is distinguished from *Boletus* by the tubes not being easily separated from the hymenophore and by the hymenium having a perceptibly radiating structure. BOLETUS—103 species; the six following being described as new: *B.* (*Viscipellis*) *hirtellus; B.* (*Subpruinosi*) *dictyocephalus; B.* (*Calopodes*) *rimosellus; B.* (*Calopodes*) *flexuosipes; B.* (*Edules*) *leprosus; B.* (*Luridi*) *subvelutipes.* STROBILOMYCES—2 species. This genus is distinguished from *Boletus* by the tubes being not easily separable from the hymenophore and by the hymenium being without a perceptibly radiating structure. The author remarks that by the former character and by the tough sub-

stance the transition between *Boletus* and *Polyporus* is made. Out of the 110 described, 18 species and 2 varieties are recorded as edible; but of these the three we have marked by Roman type are regarded with suspicion. The edible species are as follows:

Boletus elegans, Schum.; *B. Clintonianus*, Pk.; *B. luteus*, L.; B. granulatus, L.; *B. Collinitus*, Fr.; *B. badius*, Fr.; *B. bovinus*, L.; *B. rubinellus*, Pk.; *B. miniato-olivaceus*, Frost.; *B. miniato-olivaceus*, var. *sensibilis*, Pk.; B. chrysenteron, Fr.; *B. subtomentosus*, L.; *B. edulis*, Bull.; *B. æstivalis*, *B. impolitus*, Fr.; B. versipellis, Fr. *B. scaber*, Fr.; *B. castaneus*, Bull.; *Strobilomyces strobilaceus*, Berk.

Students will not find many *Boleti*, any more than any other kinds of fleshy fungi, during a dry season or during the dry part of any season. They are a moist, fleshy group of plants, and only thrive well where there is plenty of atmospheric humidity. Professor Peck's experience has been that a few common species of *Boleti* may be found from June to October, but that most of them occur only in July and August, the warmest part of the season, and that they are most abundant of all in very warm showery weather.

It was a happy thought which induced the author to prepare this useful monograph; and let us hope that its publication will serve as a stimulus to Rocky Mountain and Pacific coast botanists in the study of the *Boleti* of this vast and too-much neglected region.—F. W. ANDERSON and F. D. KELSEY.

THAXTER, ROLAND. *A New American Phytophthora.* Botanical Gazette, Vol. XIV, No. 11, p. 273.

Dr. Thaxter's note in the last *Gazette* will be of interest to all who know the peculiarities of this somewhat isolated genus. This new species of *Phytophthora* was found in the vicinity of New Haven, Conn., growing upon and destroying large quantities of lima beans. The pods, both young and old, seem to be best suited to the growth of the fungus, upon which it appears as a "clear white felted coating," partly or entirely covering both sides of the pods. Like its near relative, it seems to be a rapid disorganizer, soon opening the way for numerous saprophytic forms. It differs from *P. infestans*, DBy., in its larger and proportionately broader conidia, and the distinct appearance and mode of branching of the conidiophores. In its large size it seems to resemble the *P. cactorum* of Europe, but Dr. Thaxter, although not able to examine specimens of the latter, has decided that it differs specifically from the European species. He has accordingly named it *Phytophthora phaseoli*, n. s., and adds a concise description, which it may be well to repeat:

Mycelial hyphæ branched, rarely penetrating the cells of the host by irregular haustoria. Conidiophores slightly swollen at their point of exit through the stomata, arising singly or one to several in a cluster; simple or once dichotomously branched and once to several times successively inflated below their apices. Conidia oval or

elliptical, with truncate base and papillate apex; 35–50 by 20–24 μ. Germination by zoospores, usually fifteen in number, or rarely by a simple hypha of germination. Oospores unknown. On pods and stems of the lima bean (*Phaseolus lunatus*), New Haven, Conn., September and October.—DAVID G. FAIRCHILD.

THÜMEN, FELIX VON. *Die Pilze des Aprikosenbaumes* (*Armeniaca vulgaris*, Lam.). *Eine Monographie.* Klosterneuburg bei Wien. Verlag der k. k. Versuchs-Station. October, 1888. Small quarto. Paper. pp. 19.

The importance of the apricot industry in some parts of the United States, particularly in California, where there are very extensive orchards, makes this paper of considerable interest to fruit growers.

According to Professor von Thümen the apricot possesses no great longevity, but yields good fruit abundantly and can be grown satisfactorily even upon an inferior sandy soil. Early bearing partly compensates for its brief existence, and but for the number of diseases to which it is subject it would be much more generally cultivated. The author describes twenty-seven fungi which have been found on this tree either as parasites or saprophytes as follows, the former in Italics the latter in Roman type.

ON THE FRUIT.—*Phyllosticta vindobonensis*, Thüm.; *Phoma Armeniacæ*, Thüm.; *Monilia fructigena*, Pers.; *Monilia laxa*, Sacc. & Vogl.; *Glæosporium lœticolor*, Berk.; *Epochnium virescens*, Mart.; Sporotrichum lyococcon, Ehrenbg.; Melanomma Minervæ, H. Fab.

ON THE LEAVES.—*Puccinia prunorum* Lk.; *Podosphæra tridactyla*, DBy.; *Capnodium armeniacæ*, Thüm.; *Phyllosticta circumcissa*, Cooke.; *Clasterosporium amygdalearum*, Sacc.; Cladosporium herbarum, Lk.

ON THE BRANCHES AND TWIGS.—Valsa ambiens, Fr.; Valsa cincta, Fr.; Valsa leucostoma, Fr.; Eutypella prunastri, Sacc.; Cenangium prunastri, Fr.; Diplodia pruni, Fuck.; Diplodia amygdali, Cooke & Hark.; Cytispora leucostoma, Sacc. (gonidia of Valsa.); Cytispora cincta, Sacc. (gonidia of Valsa.); Cytispora rubescens, Fr.; *Coryneum Beijerinckii*, Ouds.; Melanconium fusiforme, Sacc.; Hymenula armeniacæ, Schulz & Sacc.

Some of the so-called saprophytic forms may be parasitic. Most of the species occur on other plants. Those peculiar to the apricot are *Phyllosticta vindobonensis*, *P. circumcissa*, *Phoma armeniacæ*, *Epochnium virescens*, *Capnodium armeniacæ*, *Melanconium fusiforme*, and *Hymenula armeniacæ*. It will also be observed that many of these fungi, especially the parasites, are imperfect forms, whose life history remains to be worked out.

The brief Latin description which introduces each species is followed by paragraphs on the characteristics of the disease, its distribution, and other matters of interest, including treatment for the parasites in the few cases where any has been discovered. From these notes it appears that the European *Podosphæra tridactyla* also affects damsons, prunes, and plums, especially the first, but has not been found upon the cherry, although in this country it is common upon the latter. *Monilia laxa* is generally confounded with *M. fructigena*. It

occurs only on plums, prunes and apricots. *Capnodium armeniacæ* is described solely from mycelium and gonidia. *Phyllosticta circumcissa* and *Clasterosporium amygdalearum* make "shot holes" in the leaves. Both are serious evils, the *Phyllosticta* being specially prevalent in the orchards of South Australia. The use of the term perithecia for receptacles containing only gonidia is not to be commended.—ERWIN F. SMITH.

VIALA, PIERRE. *Une Mission Viticole en Amerique.* Published at Montpellier, No. 5 Grand Street, by C. Coulet, and at Paris, No. 120 Boulevard St. Germain, by G. Masson. 1889.

This work (387 pages), illustrated by eight chromo-lithographs and a geologic map of the United States, contains the observations upon American grape-vines and their maladies, made by Professor Viala during a tour through the United States in 1887. By the French Government Professor Viala was commissioned to inspect the grape-vines, native of America, which might be found growing in marly or calcareous soils, with the view of finding a species of vine adaptable to culture on similar soils in France. In the preface to his book Professor Viala states that it "is not a report of his work upon this viticultural mission, but rather a study, complete as possible, of all the questions relative to American grape-vines and to the maladies of the vine in the country of their origin." With such a scope, the studies of this distinguished botanist will be of important interest to botanists and viticulturists of America as of Europe. In his extended tour throughout the United States Professor Viala was aided by our Government, and accompanied officially by Prof. F. Lamson Scribner, then Chief of the Section of Vegetable Pathology, United States Department of Agriculture, and now of the Agricultural Experiment Station, Knoxville, Tenn. According to Viala, there are of American vines eighteen known species. In the other parts of the earth there are but twelve; one species in Europe; the others in Asia. *Vitis vinifera* is indigenous to Europe. Of our native vines, those of interest to French viticulture, either as fruit-bearers or as graft-bearers, for the viniferas, are *Vitis Berlandieri*, *V. cordifolia*, *V. rupestris*, *V. riparia*, and sundry varieties of these species.

Of our long list of cultivated varieties but few find favor with Viala, being generally stigmatized as "*foxy.*" This, however, is a matter of national taste. Wines which Frenchmen condemn are approved by Americans and Germans; while Frenchmen long resident with us learn by habitude to prefer the high-flavored American wines. The day may come when the "*peculiar*" flavor of the *Labrusca* and of the *Riparia* may be esteemed as a commendation. "*De gustibus non disputandum.*"

Part second of Viala's volume is devoted to an exhaustive study of "the maladies of the vine in America"—black rot, white rot, bitter rot,

anthracnose, oidium, and other fungi, together with suggestions for their treatment; also a formidable list of insect enemies to the vine and its fruits; and an appendix treating of the adaptation of American vines to soils.

Altogether this work of the distinguished botanist is of standard interest, and in its preface we have the assurance that it will be soon followed by a second volume, wherein Viala will record personal observations made in travel through our country, and also "Studies upon Viticulture and Vinification in the United States." The volume under consideration is of especial interest to scientists; the volume to come will surely be instructive to the practical student of viticulture and viniculture.—A. W. PEARSON.

WAKKER, J. H. Contributions a la pathologie végétale: (1) *La morve des Anémones, produite par le Peziza tuberosa*, Bull.; (2) *Nouvelle recherches sur la gommose des Jacinthes et plantes analogues*; (3) *Les renflements des branches de quelques espèces de Ribes*; reprint from *Archives Néerlandaises*, Tome XXIII, p. 373–400, with 2 plates on Gummosis.

(I.) The author completes some observations on a disease of anemones known as black rot, and due to *Peziza tuberosa*. This fungus occurs principally on *Anemone Coronaria*, its varieties and hybrids, these being the sorts most frequently planted. It has also been observed on *A. ranunculoides* and *A. nemorosa*.

The symptoms of the disease are essentially the same in all the species. The leaves turn brown, wither early, and pull up very readily. The root-stock is the part first attacked and the chief seat of the disease, but the base of the petioles may also become involved. In a normal condition the interior of the root-stock shows the milk-white color of ordinary starch-bearing parenchyma, but under the influence of this fungus it assumes a gray tint, and becomes soft and easy to crush between the fingers. Large mycelial filaments penetrate this soft mass in all directions, passing between the cells and through them. These filaments were traced into the firm tissues of the rhizome. There their very blunt extremities are found only between the cells, the filaments, as in many other cases, growing around and between the cells before determining their destruction.

When the diseased plants are left undisturbed in the earth, the mycelium produces large sclerotia, easily mistaken for the root-stocks of *A. coronaria*, a fact which singularly favors the spread of the fungus.

Toward the end of April these sclerotia begin to produce the ordinary *Peziza* cups. These are a uniform milk and chocolate color, 55 mm long; 3 mm thick; with a disk breadth of 15 mm. Some other measurements are: asci, 190 x 12 μ.; paraphyses, 190 x 2 μ.; spores, 16 x 8 μ. For admirable figures of the *Peziza* form, see Tulasne *S. F. C.* III, Tab. 22, Figs. 1–5.

In the ascus, or in water, the spores send out long tubes within 24 hours, and produce sporidia in 48 hours, after which they perish. These sporidia occur in great numbers (see also Brefeld, IV., Pl. IX, Fig. 16–19), but are functionless. The case is otherwise on nutrient media. The author used a decoction of raisins, solidified by the addition of gelatine and sterilized by discontinuous heat. This substratum is easy to prepare and very suitable for the development of mucedineous facultative parasites. By germinating the ascospores on slides in drops of this gelatine and transferring the mycelium after four days to Van Tieghem cells, the bottoms of which were covered with gelatine, he obtained a most luxuriant growth, but no sclerotia during the whole life of the mycelium, which exceeded three months.

This fungus needs a start before it is strong enough to attack healthy tissues. Infection takes place by means of the mycelium, and hence, except in rare cases, it is possible only through the parts underground. Ascospores sown on fresh cuts of different rhizomes gave no results; but two rhizomes taken from the same pot were quickly infected (in four days) and destroyed with the usual symptoms, by bringing them into contact with some mycelium taken from one of the cell cultures. When the spores find their way into the soil, especially when they lodge on the posterior decaying end of the rhizone, they are undoubtedly in a condition favorable to robust growth, and have an excellent opportunity to attack the plant.

Dr. Wakker discusses the relation of *P. tuberosa* to *P. bulborum*, which attacks hyacinths and related *Liliaceæ* in the same locality. The chief difference lies in the size of most of the organs, those of *P. bulborum* being smaller. The spore measurements, however, are identical, so that he would be inclined to doubt the specific difference were not the conviction universal among horticulturists that the disease never passes from hyacinths to anemones, or inversely.

The ascus form is common in *P. tuberosa*. In the hyacinth disease, and other sclerotial diseases, the *Peziza* cups rarely develop. For this reason, and others, the author inclines to believe that *P. tuberosa* is the species truly indigenous to Central Europe and that *P. sclerotiorum* and *P. bulborum* are derivatives from this original stock, changed conditions having produced slight modifications, forming distinct but very closely related species.

(II.) The author is able to throw some additional light on the gummosis of the hyacinth. He has also discovered gummosis in the tulip and in *Tecophilea cyanocrocus*. A similar degeneration also occurs in *Ixia* bulbs (Dr. Masters) and in *Cyclamen* leaves (Prillieux).

The very small gum pockets in the substance of the inner scales of the hyacinth are pure white, and their walls are still composed of living cells. These pockets are not limited, however, to the youngest scales, but invade even the outermost tunics and are often large, the walls becoming dead and structureless and the gum exuding on the surface of

the bulb in small drops. These superficial drops frequently contain mycelium, but, as in previous examinations, none could be found in any of the closed pockets, even by the most approved and delicate methods of section cutting and staining. A similar examination of tulip bulbs led to the same result. There is also no ground for belief that gummosis is due to the attacks of *Tylenchus*. Although Beyerinck found gummosis to be communicable in the *Amygdaleæ*, the author so far has not been able to produce it artificially in hyacinths. The moistened gum did not increase in quantity, or cause any gummy degeneration of surrounding tissues when put into wounds or on the cut surface of bulbs. From two experiments in which bulbs were kept for a long time in moist earth at a high temperature (30° to 37° C.), and from considerations published elsewhere, the author concludes that the stinking white rot of the bulbs is always preceded by gummosis. In conclusion he says:

> The little we know to-day on the subject of gum formation in bulbous plants may be summarized as follows:
>
> (1) The gum is found essentially either between the parenchyma cells of the scales or else between the epidermis and the parenchyma.
>
> (2) In the vicinity of a gum pocket the starch disappears from the parenchyma cells and is replaced by gum.
>
> (3) Those cells totally deprived of starch are not only completely alive, but may increase much in size and even divide tangentially.
>
> (4) In the cells which have died prematurely the starch remains unchanged.
>
> (5) Lining the greater part of the wall of cells, which surrounds the cavity, is a layer of gum of greater density (as shown by its yellow color) than that which occupies the center of the cavity.
>
> (6) Gummosis and the white rot are one and the same disease.
>
> (7) Of a parasitic cause there is no trace.

(III.) The author describes what he calls a *rhizomania* in species of Ribes, *i. e.*, a tendency in the branches to the formation of numerous, incipient, adventitious roots. These abnormal roots either do not pierce the bark or dry up and die as soon as they have done so, leaving only slight conical prominences. The result of these numerous growths is a hypertrophy and degeneration of various tissues, especially of the bark, with the formation of black or brown, rough and irregular, roundish or elongated tumors, having a diameter many times greater than that of the normal branch. Main stems, robust vertical branches, and shoots of the first year show no trace of these tumors, and where only a single root was formed the author observed no pathologic change.

These growths differ from the ordinary production of roots on branches in the following particulars: (1) The disposition of the roots appears to be entirely independent of the force of gravity or the direction of the light. (2) These roots also differ essentially in that their production is not restricted but goes on indefinitely to the formation of tumors. The author has been able to find in literature no mention of any analogous fact. In some respects the growths suggest "witch brooms," but the author could find no traces of any animal or vegetable parasite.—ERWIN F. SMITH.

ZACHAREWICZ, ED. *Traitement de la Maladie des Pommes de Terre, des Tomates et des Melons, par les Sels de Cuivre.* Le Progrès Agricole et Viticole, 14 Juillet, 1889.

The author gives in this brief note a few points of practical value in the treatment of potato and tomato rot, *Phytophthora infestans*, DBy., especially as testing the efficacy of the eau celeste and sulphosteatite, a mixture of one part of powdered copper sulphate to nine of talc, "it being well known that alternate treatments of Bordeaux mixture and this powder have proved generally successful."

For the purpose of experimentation three lots of tomato vines were taken. The plants of the first were grown in hot beds upon trellises and carefully guarded against rapid changes of temperature by raising and lowering the sashes. Those of the second and third lots were grown without any trellises in the open air, exposed to natural conditions. In the first set, guarded from the heavy dews, present in that locality in the month of June, only three sprayings with eau celeste given at intervals of fifteen days, preserved the plants perfectly from the disease. The second, exposed to ordinary climatic conditions, was sprayed upon May 8, and 28, and June 18, with eau celeste, and dusted May 20, June 8, and 26, with the mixture of copper sulphate and talc. By this treatment the disease, which appeared first May 26, was stopped and the fruits completely preserved, while a number of plants to one side, left unsprayed, lost by June 10, not only their leaves, but the greater part of their fruit. The third set, which differed from the second only in that all six sprayings, made about the same time, were with eau celeste, failed to give as satisfactory results, at least one-third of the fruits being destroyed by the rot. This difference in favor of the second lot the author thinks is due to the alternate use of the copper solution and the sulphosteatite, and draws the following conclusions from his experiments: That, the malady having its seat in the organs of the plant, all successful treatment must be preventive, consequently commenced before transplanting and continued at intervals of fifteen to twenty days, care being taken to treat in the intervals with sulphosteatite; that it is best not to modify the formula for eau celeste given by Mr. Audoynaud—1 pound of sulphate of copper in 2 gallons of water and $1\frac{1}{2}$ pints of ammonia, diluted with 22 gallons of water when cool; and that the sulphosteatite should be applied at the rate of $14\frac{1}{2}$ pounds to the acre, preferably early in the morning.—DAVID G. FAIRCHILD.

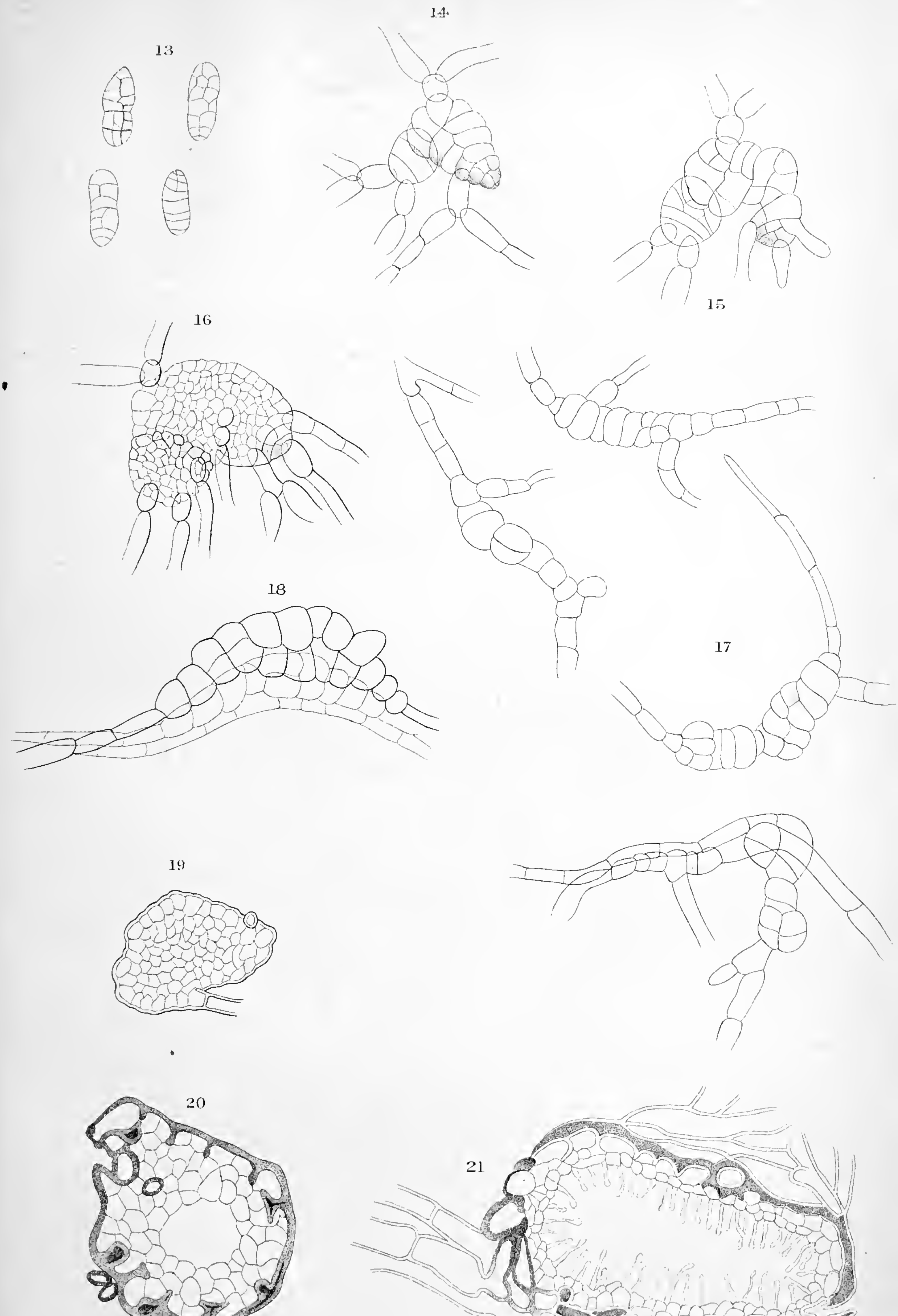
DESCRIPTION OF PLATES.

PLATE XIII (*after Von Tavel.*)

FIG. 13. *Cucurbitaria platani*, Von Tav.; ascospores × 380.
14. Formation of sporopycnidium; the spore three days after sowing. × 380.
15. The same spore five hours later × 380.
16. The same spore twenty hours later × 380.
17. Beginnings of pycnidia × 600.
18. A later stage of the same × 600.
19. Section through a young pycnidium, the cavity not yet formed × 700.
20. Section through an older pycnidium × 700.
21. Section through a fully-formed pycnidium × 700.

PLATE XIV (*G. Massee, del.*)

FIG. 1. *Tremella tremelloides*, (Berk.) Mass., portion of a plant, natural size.
1 *a*. Basidia and spores of same × 400.
2. *Stella Americana*, Mass.; specimen natural size.
2 *a*. Vertical section of same, natural size; (*a*) outer wall of peridium; (*b*) inner layer.
2 *b*. Spores of same × 350.
2 *c*. Spore of same, showing epispore, as seen when × 1,200.
3. *Trichosporium Curtisii*, Mass.; portion of a specimen natural size.
4. *Trichosporium phyrrhosporium*, (Berk.) Mass.; (*a*) conidia; (*b*) a condiophore detached from its hypha, all × 350.
5. *Trichosporium apiosporium*, (B. & Br.) Mass.; conidia × 350.
6. *Badhamia nodulosa*, (Cke. & Balf.) Mass.; entire specimens × 40.
6 *a*. Portion of capillitium and spores of same × 350.
6 *b*. Spore of same × 1200.
7. *Physarum scyphoides*, Cooke and Balf.; specimens × 40.
7 *a*. Portion of capillitium and spores of same × 350.
7 *b*. Spore of same × 1200.
8. *Tilmadoche gyroecephala*, Rost.; specimen × 40.
8 *a*. Portion of capillitium and spores of same × 350.
8 *b*. Spore of same × 1200.



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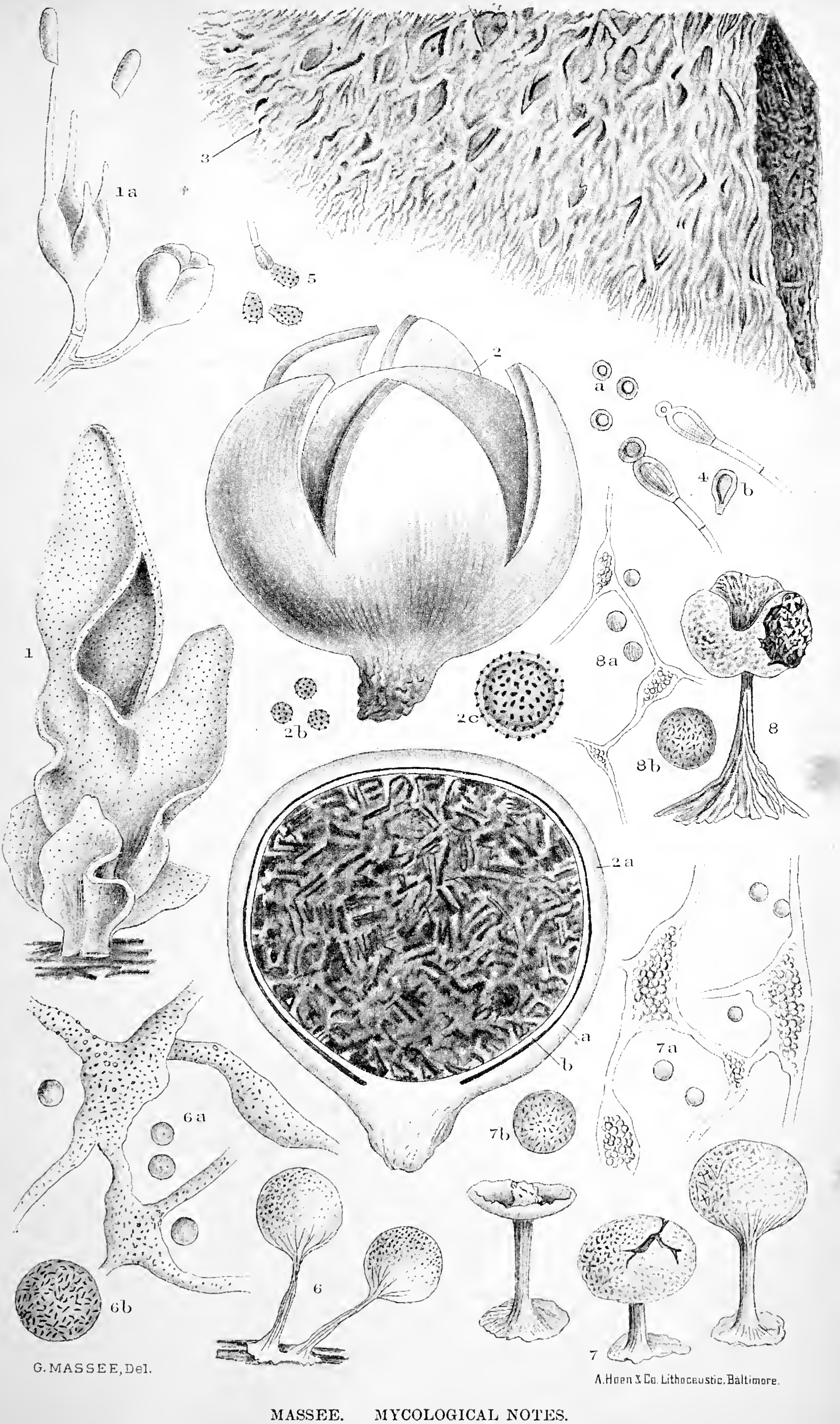
VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

CUCURBITARIA PLATANI.



MASSEE. MYCOLOGICAL NOTES.

GENERAL INDEX.

INDEX TO FUNGI.

[NOTE.—Fungi described in the text are in small capitals, synonyms in italics.]

INDEX TO HOSTS.

NAMES AND ADDRESSES OF CONTRIBUTORS.

Anderson, F. W., Great Falls, Mont.
Burrill, T. J., Champaign, Ill.
Cockerell, T. D. A., Westcliffe, Custer County, Colo.
Ellis, J. B., Newfield, N. J.
Everhart, Benjamin M., West Chester, Pa.
Fairchild, David G., Agricultural Department, Washington, D. C.
Fairman, Chas. E., Lyndonville, Orleans County, N. Y.
Galloway, B. T., Agricultural Department, Washington, D. C.
Goff, E. S., Madison, Wis.
Halsted, B. D., New Brunswick, N. J.
Kellerman, W. A., Manhattan, Kans.
Kelsey, Rev. F. D., Helena, Mont.
Knowles, Etta A., St. Joseph, Mo.
Massee, George, Kew, England.
McAdam, Robert K., 4 Rutland square, Boston, Mass.
Pearson, A. W., Vineland, N. J.
Smith, Erwin F., Agricultural Department, Washington, D. C.
Southworth, Effie A., Agricultural Department, Washington, D. C.
Swingle, W. T., Manhattan, Kans.
Weed, Clarence M., Experiment Station, Columbus, Ohio.
Wight, Allan R., Auckland, New Zealand.